PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XX. Nos. 274—287.

JANUARY—DECEMBER, 1904.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1905.

RICHARD CLAY AND SONS, LIMITED,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to R. D. Abell, to investigate the products from condensation of ethylphenylketone with benzaldehyde.

£10 to J. B. Cohen, to investigate the chlorination and bromination of the aromatic hydrocarbons. Oxidation of the substituted toluenes.

£5 to J. B. Cohen, to continue the investigation on the chlorination and bromination of the aromatic hydrocarbons. Oxidation of the substituted toluenes.

£10 to A. W. Crossley, to investigate the action of phosphorus haloids on substituted dihydroresorcins, and the preparation of hydroaromatic hydrocarbons from the resulting derivatives.

£10 to H. D. Dakin, for the investigation of certain aromatic bases allied to adrenaline.

£10 to F. E. Francis, to investigate the action of nitrogen sulphide on organic substances.

£15 to A. Lapworth, for the investigation of some properties of $\alpha\beta$-unsaturated ketones, acids, and allied compounds.

£10 to H. R. Le Sueur, to investigate the action of heat on α-hydroxy-acids.

£10 to T. M. Lowry, for further studies of dynamic isomerism.

£25 to A. McKenzie, to investigate the studies in asymmetric synthesis.

£10 to J. W. Mellor, for the investigation of the constitution of silicates.

£20 to H. A. Miers, for the investigation of the regular growth of crystals of one substance upon those of another.

£10 to R. S. Morrell and E. K. Hanson, to investigate the oxidation of α- and β-crotonic acids.

£10 to R. H. Pickard, to investigate the optically active carbimides.

£5 to F. G. Pope, condensation of aromatic hydroxy-acids of the type of *o*-hydroxymandelic acid with resorcinol.

£5 to C. Smith, to investigate the derivatives of tetrahydronaphthalene with regard to their naphthalenoid and benzenoid characteristics.

£10 to J. J. Sudborough, for the continuation of the investigation on "Steric Hindrance" and on polynitro-compounds.

£10 to J. J. Sudborough, for the continuation of the investigation on "Steric Hindrance" and on polynitro-compounds.

£10 to G. Tattersall, to investigate the preparation of *trans*-glutaconic acid. Synthesis of inactive sylvestrene, of isocaprolactone, and their derivatives.

£10 to J. F. Thorpe, for the investigation on the formation of derivatives of trioxypyridine from ethyl α-cyano-β-imino-glutarate and its alkyl derivatives.

£5 to W. E. S. Turner, for the investigation of the effect of alcohol on the rate of saponification of esters.

LIST OF FELLOWS ELECTED DURING 1904.

Name.	Proposed.	Elected.
Ackroyd, John Prest	January 20th, 1904	February 17th.
Allen, William Harold Richard	June 15th, 1904	December 1st.
Baguley, Allan	November 18th, 1903.	February 17th.
Barbour, William	February 17th, 1904.	May 5th.
Bellars, Albert Ernest	April 20th, 1904	June 15th.
Benn, R. H. Durward	February 17th, 1904.	May 5th.
Bennett, Charles Thomas	January 20th, 1904	February 17th.
Benson, Alick Cole	December 16th, 1903.	,, ,,
Bentley, Walter Henry	November 3rd, 1904.	December 1st.
Black, John Wyclif	,, ,, ,,	,, ,,
Brand, Herbert Frank	April 20th, 1904	June 15th.
Bridgett, Robert Currie	February 4th, 1904	May 5th.
Broderick, George Edward Peach	January 20th, 1904	February 17th.
Busher, Thomas Story	November 3rd, 1904.	December 1st.
Caldecott, Lawrence	November 3rd, 1904.	December 1st.
Caldwell, Robert John	,, ,, ,,	,, ,,
Clark, Peter Skinner	,, ,, ,,	,, ,,
Clayton, Ellis	February 17th, 1904.	May 5th.
Cooper, Jabez Horace	June 15th, 1904	December 1st.
Cowper, Alfred Denys	December 3rd, 1903.	February 17th.
Crabb, William	November 3rd, 1904.	December 1st.
Cunningham, James Edward	,, ,, ,,	,, ,,
Dalton, William Herbert	June 2nd, 1904	December 1st.
Deane, Harold	November 3rd, 1904.	,, ,,
Dickinson, Francis	,, ,, ,,	,, ,,
Drugman, Julien	January 20th, 1904	February 17th.
Evans, Edward	November 3rd, 1904.	December 1st.
Evans, John	June 2nd, 1904	,, ,,
Evans, Nevil Norton	December 3rd, 1903.	February 17th.
Fagan, Thomas Wallace	November 3rd, 1904.	December 1st.
Field, W. Eddington	May 5th, 1904	June 15th.
Finlow, Robert Steel	March 3rd, 1904	May 5th.
Forrest, James Rocheid	November 18th, 1903.	February 17th.
Forrest, John Kerr	November 3rd, 1904.	December 1st.
Fry, George	January 20th, 1904	February 17th.
Gawler, Robert	December 16th, 1903.	February 17th.
Gerard, Thomas Alfred	April 20th, 1904	June 15th.
Ghose, Anu	January 20th, 1904	February 17th.
Gilchrist, James Gray	April 20th, 1904	June 15th.
Glover, Harry James	November 18th, 1903.	February 17th.
Goodson, John Augustus	,, ,, ,,	,, ,,
Guthrie, John Monteath	December 3rd, 1903.	,, ,,

Name.	Proposed.	Elected.
Guttmann, Leo Frank	December 16th, 1903.	February 17th.
Hammond, Harold Sankey	March 16th, 1904	May 5th.
Harold, Frederick Clarkson	November 3rd, 1904.	December 1st.
Henzell, Archie Willoughby	June 2nd, 1904	,, ,,
Hodgson, Thomas Reginald	November 3rd, 1904.	,, ,,
Hoit, Alfred Henry	November 18th, 1903.	February 17th.
Horn, George Mathieson	March 3rd, 1904	May 5th.
Horrod, George William Thomas	November 3rd, 1904.	December 1st.
Hulme, John	May 5th, 1904	June 15th.
Inglis, John Kenneth Harold	November 3rd, 1904.	December 1st.
James, Thomas Campbell	November 3rd, 1904.	December 1st.
James, Walter Richmond	,, ,, ,,	,, ,,
Jenkins, Herbert	May 18th, 1904	June 15th.
Johnson, John Richard	November 3rd, 1904.	December 1st.
Johnston, John Haslam	April 20th, 1904	June 15th.
Jones, Horace Francis	November 3rd, 1904.	December 1st.
Jones, William App	,, ,, ,,	,, ,,
Joseph, Alfred Francis	,, ,, ,,	,, ,,
Komppa, Gustav	November 16th, 1904.	December 1st.
Lauder, James Stanley	November 3rd, 1904.	December 1st.
Le May, Percy Kent	February 17th, 1904.	May 5th.
Lessing, Rudolf, Ph.D.	May 18th, 1904	June 15th.
Levy, Arthur Garfield	November 3rd, 1904.	December 1st.
Longstaff, James Patrick	,, ,, ,,	,, ,,
Lowe, Frank Harold	May 18th, 1904	June 15th.
McCourt, Cyril Douglas	December 16th, 1903.	February 17th.
McDougall, Arthur Thomas	November 3rd, 1904.	December 1st.
Mander, Alfred	March 3rd, 1904	May 5th.
Mathews, Harold Joseph Clarke	November 3rd, 1904.	December 1st.
Mears, Francis D'Oyley, Jun.	January 20th, 1904	February 17th.
Middleditch, Bernard	November 18th, 1903.	,, ,,
Millar, Ernest Westby	November 3rd, 1904.	December 1st.
Montgomery, Jack Percival	January 20th, 1904	February 17th.
Moore, Tom Sidney	February 4th, 1904	May 5th.
Murray, Benjamin L.	December 16th, 1903.	February 17th.
Oakden, William Edward	May 18th, 1904	June 15th.
Oldfield, Laurel Cecil Francis	March 16th, 1904	May 5th.
Page, William Davidge	March 16th, 1904	May 5th.
Patterson, Thomas Stewart	December 16th, 1903.	February 17th.
Pell, Alfred	April 20th, 1904	June 15th.
Phillips, George Frederick	June 15th, 1904	December 1st.
Pinchbeck, Gerald	March 3rd, 1904	May 5th.
Pinkerton, David John	April 20th, 1904	June 15th.
Porter, Thos. Linton Daniel	March 16th, 1904	May 5th.
Prentice, Bertram	November 18th, 1903.	February 17th.
Riley, Louis John Eczekiel	March 16th, 1904	May 5th.
Robertson, Franklin Ernest	February 17th, 1904.	,, ,,
Rodger, Robert	May 18th, 1904	June 15th.

Name.	Proposed.	Elected.
Rouillard, Marie Jean Louis Ernest	November 3rd, 1904. .	December 1st.
Sanders, Percy Richard	April 20th, 1904	June 15th.
Sawer, Charles John.....	May 18th, 1904	,, ,,
Sen, Jatindranâth.....	January 20th, 1904...	February 17th.
Shacklady, Thomas George.....	February 17th, 1904..	May 5th.
Shelton, Henry Stanley	May 18th, 1904	June 15th.
Shrubsole, Alfred	December 16th, 1903.	February 17th.
Siau, Raymond Louis	January 20th, 1904...	,, ,,
Smith, Clarence	February 4th, 1904...	May 5th.
Smith, Gerald Oscar Morgan	,, ,, ,,	,, ,,
Smith, Henry Heron	March 16th, 1904.....	,, ,,
Smith, Samuel John	December 16th, 1903.	February 17th.
Spielmann, Percy Edwin.....	November 3rd, 1904..	December 1st.
Stanger, Reginald Harry Hursthouse ...	February 4th, 1904...	May 5th.
Stanley, Harry	November 3rd, 1904. .	December 1st.
Stevenson, Henry Ernest	January 20th, 1904...	February 17th.
Streatfeild, Frederick Henry	November 18th, 1903.	,, ,,
Struthers, Robert de Jersey Fleming- ...	March 3rd, 1904.....	May 5th.
Sutcliffe, Thomas	November 3rd, 1904. .	December 1st.
Thibault, Paul John	November 3rd, 1904..	December 1st.
Thompson, Charles Herbert	January 20th, 1904...	February 17th.
Thompson, Hubert	,, ,, ,,	,, ,,
Tingle, Alfred	December 16th, 1903.	,, ,,
Tong, Walter	March 3rd, 1904	May 5th.
Tonkin, Arnold Bertram..	June 2nd, 1904	December 1st.
Twiss, Douglas Frank	November 3rd, 1904..	,, ,,
Underhill, William Wood	November 18th, 1903.	February 17th.
Walling, Léon Edward	January 20th, 1904...	February 17th.
Watson, Edwin Roy.....	June 15th, 1904	December 1st.
Watson, Herbert Wood	November 3rd, 1904..	,, ,,
Watt, Francis Langston	November 18th, 1903.	February 17th.
Weeks, Henry Bridges.....	June 2nd, 1904	December 1st.
Weinberg, John	February 4th, 1904	June 15th.
Whiteley, Charles Edward	January 20th, 1904...	February 17th.
Wilkinson, James Alfred.....	April 20th, 1904	June 15th.
Willcox, William Henry..	November 3rd, 1904..	December 1st.
Woodcock, William Henry.....	January 20th, 1904...	February 17th.
Wyeth, Frank John.....	November 3rd, 1904. .	December 1st.
HONORARY AND FOREIGN MEMBERS.		
Becquerel, Antoine Henri	May 5th, 1904..... .	May 18th.
Lobry de Bruyn, Cornelis Adriaan.....	,, ,, ,,	,, ,,
Clarke, Frank Wigglesworth	,, ,, ,,	,, ,,
Curie, (Madame) Marie	,, ,, ,,	,, ,,
Liebermann, Carl Theodor	,, ,, ,,	,, ,,
Morley, Edward Williams	,, ,, ,,	,, ,,

FELLOWS DECEASED, 1904.

Name.	Elected.	Died.
Allen, Alfred Henry	February 18th, 1864	July 14th, 1904.
Allhusen, F. E.	May 3rd, 1894	October 17th, 1904.
Barclay, John	March 4th, 1897	July 19th, 1903.
Bell, Sir Isaac Lowthian	December 3rd, 1863	December 20th, 1904.
Benger, Frederick Baden	November 19th, 1874	January 28th, 1903.
Beringer, Cornelius	June 21st, 1883	August 28th, 1903.
Dilimoria, Hormasji Naoroji	December 6th, 1900	August 5th, 1904.
Chattaway, William	December 5th, 1895	October 7th, 1904.
Dey, Pro Lall	March 4th, 1886	August 11th, 1904.
Dodd, Thomas Henry	December 2nd, 1875	January 22nd, 1904.
Dodd, William Henry	April 19th, 1888	June 24th, 1899.
Doran, Robert Elliott	May 20th, 1886	October 13th, 1904.
Francis, William	November 7th, 1842	January 19th, 1904.
Gibson, Adam	March 5th, 1885	August 19th, 1904.
Grenfell, Claude G.	March 1st, 1883	January 26th, 1901.
Grimshaw, Harry	February 19th, 1874	January 29th, 1904.
Howsam, George	April 22nd, 1903	July 25th, 1904.
Isherwood, Thomas	February 16th, 1882	January 13th, 1904.
Jackson, John	December 15th, 1892	January 23rd, 1904.
Kitchin, Archibald	June 19th, 1873	March 5th, 1904.
*Lobry de Bruyn, Cornelis Adriaan	May 18th, 1904	July 23rd, 1904.
*Markownikoff, Wladimir Wasiljevič	January 20th, 1898	February 11th, 1904.
Mason, James	November 4th, 1858	April 2nd, 1903.
Munro, Donald	December 7th, 1871	August 13th, 1904.
Pooley, Thomas Alexander	March 6th, 1862	December 8th, 1904.
St. John, Harry	April 21st, 1898	February 14th, 1904.
Sawer, Charles John	June 15th, 1904	August 23rd, 1904.
Stanger, W. Harry	March 17th, 1887	February 13th, 1903.
Swan, Robert McNair Wilson	June 20th, 1889	March 25th, 1904.
Williamson, Alexander William	May 15th, 1848	May 6th, 1904.

* Honorary and Foreign Member.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1904.

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12. The action of heat on α-hydroxycarboxylic acids. A preliminary note. By Henry Rondel Le Sueur	14	—
13. The fusion of *iso*pilocarpine with caustic potash. A correction. By Hooper Albert Dickinson Jowett	14	—
14. Organic derivatives of silicon. Preparation of alkylsilicon chlorides. By Frederic Stanley Kipping	15	—

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20. Resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents. By Robert Selby Morrell and Edward Kenneth Hanson	20	197
21. Aromatic compounds obtained from the hydroaromatic series. Part I. The action of bromine on 3 : 5-dichloro-1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene. By Arthur William Crossley	21	264
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79. The resin acids of the *Coniferæ*. Part I. The constitution of abietic acid. By Thomas Hill Easterfield and George Bagley.....	112	1238
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92. The formation of periodides in nitrobenzene solution. Part II. Periodides of the alkali and alkaline earth metals. By Harry Medforth Dawson and Ethel Elizabeth Goodson	126	796
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106. The union of hydrogen and chlorine. Action of the silent discharge on chlorine. By Joseph William Mellor	140	—
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109. The influence of solvents on the rotation of optically active compounds. Part V. The optical activity of certain tartrates in aqueous solution. By Thomas Stewart Patterson	142	1116
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117. Our present knowledge of the chemistry of indigo. By William Popplewell Bloxam	159	—
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ADDITIONS TO THE LIBRARY DURING THE YEAR 1904.

Abel, Sir Frederick Augustus, Bart. *See* Imperial Institute.

Ahrens, Felix B. Handbuch der Elektrochemie. Zweite Auflage. pp. x + 686. ill. Stuttgart 1903.

Appel, O. *See* Hager, Hermann.

Arnold, Carl. Compendium of chemistry, including general, inorganic, and organic chemistry. Translated by John A. Mandel. pp. 627. New York 1904.

Atwater, W. O., and Benedict, F. G. Experiments on the metabolism of matter and energy in the human body, 1900—1902 (U.S. Dept. of Agriculture, Office of Experiment Stations. Bulletin No. 136.) Washington 1903.

Austen, Peter T. *See* Langworthy, C. F.

Balfour, Andrew. *See* Gordon Memorial College, Khartoum.

Baskerville, Charles. The elements: verified and unverified. (From the *Proc. Amer. Assoc. Advance. Sci.*, 53, 1904.)

Baskerville, Charles, and Kunz, George F. Effects on rare earth oxides produced by radium-barium compounds and on the production of permanently luminous preparations by mixing the latter with powdered minerals. (From the *Amer. J. Sci.*, 17, 1904.)

Baskerville, Charles, and Turrentine, J. W. Contributions to the chemistry of the rare earths. (From the *J. Amer. Chem. Soc.*, 26, 1904.)

—— *See* Kunz, George F.

Beach, S. A., Clark, V. A., and Taylor, O. M. Spray mixtures and spray machinery. (New York Agric. Exper. Station. Bulletin No. 243.)

Beadle, Clayton. Chapters on papermaking. Vol. I. Comprising a series of lectures delivered on behalf of the Battersea Polytechnic Institute in 1902. pp. 151. London 1903.

Behring, E. von. The suppression of tuberculosis, together with

observations concerning phthisiogenesis in man and animals, and suggestions concerning the hygiene of cow stables and the production of milk for infant feeding, with special reference to tuberculosis. Translated by Charles Bolduan. pp. vi + 85. New York 1904.

Benedicks, Carl. Recherches physiques et physico-chimiques sur l'acier au carbone. pp. 219. ill. Uppsala 1904.

Benedict, F. G. *See* Atwater, W. O.

Benedikt, Rudolf. Analyse der Fette und Wachsarten. Vierte, erweiterte Auflage, bearbeitet von Ferdinand Ulzer. pp. xii + 941. ill. Berlin 1903.

Biddle, H. C. *See* Pictet, Amé.

Bigelow, W. D. Foods and food control. I. Legislation during the year ended July 1, 1903. (U.S. Dept. of Agric. Bureau of Chemistry Bulletin, No. 83, Part I.) Washington 1904.

Bischof, Carl. Die feuerfesten Tone. Deren Vorkommen, Zusammensetzung, Untersuchung, Behandlung und Andwendung. Mit Berücksichtigung der feuerfesten Materialien überhaupt. Dritte Auflage von Hermann Kaul. pp. viii + 446. ill. Leipzig 1904.

—— Gesammelte Analysen der in der Thonindustrie benutzten Mineralien und der daraus hergestellten Fabrikate. pp. 165. Leipzig 1901.

Bischoff, C. A. Materialien der Stereochemie in Form von Jahresberichten, 1894—1902. 2 vols. pp. cxxxvi + 1977. Braunschweig 1904.

Böhmer, C. Die Kraftfuttermittel, ihre Rohstoffe, Herstellung, Zusammensetzung, Verdaulichkeit und Verwendung, mit besonderer Berücksichtigung der Verfälschungen und der mikroskopischen Untersuchung. pp. xi + 650. ill. Berlin 1903.

Bolduan, Charles. *See* Behring, E. von.

—— *See* Rotoski, O.

—— *See* Wassermann, A.

Bolton, Henry Carrington. A select bibliography of chemistry, 1492—1902. 2nd supplement. Smithsonian Miscellaneous Collections. Vol. xliv. Washington 1904.

Borchers, W. Die Beziehungen zwischen Äquivalentvolumen und Atomgewicht. Ein Beitrag zur Festigung und Vervollständigung des periodischen Systems der Elemente. pp. 17. Halle 1904.

Borns, H. Die Elektrochemie im Jahre 1903. (From *Die Chemische Industrie*, 27, 1904.)

Brandes, G. *See* Hager, Hermann.

British Fire Prevention Committee. First International Fire Prevention Congress. . . Report 1903. pp. 207. ill. London 1903.

British Guiana. Report by Professor Harrison on the results of experiments with varieties of canes carried on on sugar plantations in the colony. pp. 8. Demerara 1904.

Brough, Bennett H. Cantor lectures on the mining of non-metallic minerals. pp. 48. ill. London 1904.

Brown, A. Crum. *See* Dobbin, Leonard.

Brown, Horace T. *See* Guinness Research Laboratory.

Bürgi, R. T. Der Elektronäther. Beiträge zu einer Neuen Theorie der Elektrizität und Chemie. pp. 47. Berlin 1904.

Bull, B. W. *See* Dymond, T. S.

Cain, John Cannell. The constitution of the ammonium compounds. (From the *Mem. Manchester Phil. Soc.*, 48, 1904.)

Cape of Good Hope. Report of the Senior Analyst for the year 1903. pp. 72. 1904.

Carne, J. E. *See* New South Wales. Department of Mines and Agriculture.

Carnot, Adolphe. Traité d'analyse des substances minérales. Tome II. Métalloïdes. pp. 821. ill. Paris 1904.

Caro, N., Ludwig, A., und Vogel, J. H. Handbuch für Acetylen in technischer und wissenschaftlicher Hinsicht. Herausgegeben von J. H. Vogel. pp. xiv + 880. ill. Braunschweig 1904.

Chace, Ed. Mackay, Tolman, L. M., and Munson, L. S. Chemical composition of some tropical fruits and their products. I. A study of Cuban fruits. II. The composition of fresh and canned pine-apples. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 87.) Washington 1904.

Chemisch-technische Untersuchungsmethoden. Herausgegeben von Georg Lunge. Fünfte Auflage. Bände 1 und 2. pp. xxvi + 953 + xlix, xix + 842 + viii. ill. Berlin 1904.

Clark, V. A. *See* Beach, S. A.

Classen, A. Ausgewählte Methoden der analytischen Chemie. Band II. Unter Mitwirkung von H. Cloeren. pp. xvi + 831. ill. Braunschweig 1903.

Cloeren, H. *See* Classen, A.

Clowes, Frank, and Coleman, J. Bernard. Elementary practical chemistry. Part II. Analytical chemistry. 4th ed. pp. xvi + 212. ill. London 1903.

Clowes, Frank, and Houston, A. C. The experimental bacterial treatment of London sewage, being an account of the experiments carried out by the London County Council between the years 1892 and 1903. pp. xii + 242. ill. London 1904.

Coleman, J. Bernard. *See* Clowes, Frank.

Collin, Eugene, et Perrot, Em. Les résidus industriels de la fabrica-

tion des huiles et essences utilisés par l'agriculture comme aliments et comme engrais. pp. xi + 299. ill. Paris 1904.

Cramer, F. *See* Seger, Hermann August.

Curie, Mme. S. Untersuchungen über die radioaktiven Substanzen. Uebersetzt und mit Litteratur-Ergänzungen versehen von W. Kaufmann. pp. viii + 132. Braunschweig 1904.

Cushman, Allerton S. *See* Page, Logan Waller.

Daubeny, Charles Giles Bridle. *See* Günther, R. T.

David, A. J. *See* Dyer, Bernard.

Davis, Charles B. Steely malt in modern brewing and the filter press. (From the *Transactions of the American Brewing Institute*, 2, 1904.)

De la Coux, H. L'ozone et ses applications industrielles. Propriétés physiques—Physiologie—Production—Actions chimique et microbiologique—Applications—Analyse. pp. 557. ill. Paris 1904.

Delbrück, Max. *See* Maercker, Max.

Delbrück, M., und Schönfeld, F. System der natürlichen Hefereinzucht. Gesammelte Vorträge und Arbeiten. pp. viii + 148. Berlin 1903.

Dibdin, W. J. The purification of sewage and water. 3rd ed. pp. xxxv + 379. ill. London 1903.

Dobbin, Leonard, and Marshall, Hugh. Salts and their reactions. With preface by A. Crum Brown. pp. 198. Edinburgh 1904.

Donath, Eduard. Der Graphit. Eine chemisch-technische Monographie. pp. 175. ill. Leipzig 1904.

Dunstan, Wyndham R. *See* Imperial Institute.

Dyer, Bernard. Fertilisers and feeding stuffs. Their properties and uses. With the full text of the Fertilisers and Feeding Stuffs Act, 1893, the regulations and forms of the Board of Agriculture, and notes on the Act by A. J. David. 4th ed. pp. 124. London 1903.

—— The manuring of hops. (From the *Brewing Trade Review*, 17, 1903.)

Dymond, T. S., and Bull, B. W. On tillage crops. (Essex Field Experiments, 1896—1903, No. 2.) Chelmsford 1903.

—— Variation in the milk of a dairy herd during the summer months. pp. 15. Chelmsford 1904.

—— Variation in the milk of a dairy herd during the winter months. pp. 19. Chelmsford 1903.

Dymond, T. S., and Hughes, F. Notes on agricultural analyses, made in the County Technical Laboratories, Chelmsford, during 1901—1903. pp. 50. Chelmsford 1904.

Eder, J. M., und Valenta, E. Beiträge zur Photochemie und Spectralanalyse. pp. 868. ill. Wien 1904.

Engelhardt, Viktor. The electrolysis of water, processes and applications. Authorised English translation by Joseph W. Richards. pp. x + 140. ill. Easton, Pa. 1904.

Engler, C., und Weissberg, J. Kritische Studien über die Vorgänge der Autoxydation. pp. xi + 204.

Fairley, Thomas. The uses of lime on land. (From the *Annual Report, Yorkshire Agric. Soc.*, 1904.)

Fuller, F. D. *See* Jordan, W. H.

Gadd, H. Wippell. Drugs, their production, preparation, and properties. pp. xi + 180. London 1904.

Getman, Frederick H. Laboratory exercises in physical chemistry. pp. viii + 241. New York 1904.

Gildemeister, Eduard, and Hoffmann, Friedrich. The volatile oils. Authorised translation by Edward Kremers. pp. 733. ill. Milwaukee 1900.

Girard, Charles. Analyse des matières alimentaires, et recherche de leurs falsifications. pp. 871. ill. Paris 1904.

Gordon Memorial College, Khartoum. First report of the Wellcome Research Laboratories. By the director, Andrew Balfour. pp. 84 + iii. ill. Khartoum 1904.

Graebe, Carl. Graebe-Feier, Cassel, 20. September, 1903. pp. 138. ill. Genf 1903.

Green, Arthur G. A systematic survey of the organic colouring matters. Founded on the German of G. Schultz and P. Julius. 2nd edition. pp. x + 280. London 1904.

Grindley, H. S. The nitrogenous constituents of flesh. (From *J. Amer. Chem. Soc.*, 26, 1904.)

Grindley, H. S., and Mojonnier, Timothy. Experiments on losses in cooking meat, 1900—1903. (U.S. Dept. of Agric. Office of Experiment Stations, Bulletin No. 141.) Washington 1904.

Günther, R. T. A history of the Daubeny Laboratory, Magdalen College, Oxford. To which is appended a list of the Writings of Dr. Daubeny, and a Register of the Names of Persons who have attended the Chemical Lectures of Dr. Daubeny from 1822 to 1867, as well as of those who have received instruction in the Laboratory up to the present time. With some additional papers. pp. vii + 137 + clxiv. ill. London 1904.

Guinness Research Laboratory. Transactions. Edited by Horace T. Brown. Vol. I. Part I. pp. 141. ill. 1903.

Guttmann, Leo F. Percentage tables for elementary analysis. pp. vii + 43. London 1904.

Hager, Hermann. Das Mikroskop und seine Anwendung. Handbuch der praktischen Mikroskopie und Anleitung zu mikroskopischen Untersuchungen. Nach dessen Tode vollständig umgearbeitet und in Gemeinschaft mit O. Appel, G. Brandes, P. Stolper, neu herausgegeben von Carl Mez. Neunte Auflage. pp. xii + 392. ill. Berlin 1904.

Haldane, J. S. *See* Local Government Board.

Hall, William T. *See* Treadwell, F. P.

Hammarsten, Olof. Lehrbuch der physiologischen Chemie. Fünfte Auflage. pp. 715. Wiesbaden 1904.

Hantzsch, A. Grundriss der Stereochemie. Zweite Auflage. pp. viii + 188. Leipzig 1904.

Harding, H. A., and Nicholson, J. F. A swelling of canned peas accompanied by a malodorous decomposition. (New York Agric. Exper. Station, Bulletin No. 249, 1904.)

Harrison, John Burchmore. *See* British Guiana.

Hart, E. B. *See* Patten, A. J.

Haywood, J. K., and Warner, H. J. Arsenic in papers and fabrics. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 86.) Washington 1904.

Hecht, H. *See* Seger, Hermann August.

Henderson, G. G. Some developments in chemical theory during the nineteenth century. (From the *Proc. Roy. Phil. Soc. Glasgow*, 35, 1904.)

Heumann, Karl. Anleitung zum Experimentieren bei Vorlesungen über anorganische Chemie. Von O. Kühling. Dritte Auflage. pp. xxix + 818. ill. Braunschweig 1904.

Hime, Henry W. L. Gunpowder and ammunition, their origin and progress. pp. 256. London 1904.

Hittorf, J. W., and Plücker, J. On the spectra of ignited gases and vapours, with especial regard to the different spectra of the same elementary gaseous substance. pp. 39. ill. 1904.

Hoffmann, Friedrich. *See* Gildemeister, Eduard.

Holleman, A. F. A laboratory manual of organic chemistry for beginners. An appendix to the author's text-book of organic chemistry. Translated by A. Jamieson Walker. pp. 78. New York 1904.

Hooper, David. Silajit: an ancient Eastern medicine. (From the *Journal of the Asiatic Society of Bengal*, 72, 1903.)

—— The occurrence of Melanterite in Baluchistan. (From the *Journal of the Asiatic Society of Bengal*, 72, 1903.)

Houston, A. C. *See* Clowes, Frank.

Howard, Albert. Hop experiments, 1904. pp. 29. ill. Kent 1904.

Hughes, F. *See* Dymond, T. S.

Imperial Institute. Technical reports, and scientific papers. Edited by Wyndham R. Dunstan. With a preface by the late Sir Frederick Abel, Bart. pp. xlvii + 236. London 1903.

International Catalogue of Scientific Literature. Second annual issue. C. Physics, D. Chemistry, G. Mineralogy, Q. Physiology, R. Bacteriology. London 1903—1904.

Jahrbuch der Radioaktivität und Elektronik. Herausgegeben von Johannes Stark. Band I. 1904.

Jones, H. Chapman. The science and practice of photography. Fourth edition. pp. 569. ill. London 1904.

Jordan, W. H., and Fuller, F. D. Inspection of feeding stuffs. (New York Agric. Exper. Station, Bulletin No. 240, 1903.)

Joüet, H. Index to the literature of thorium, 1817—1902. Smithsonian Miscellaneous Collections. Vol. xliv. Washington 1904.

Julius, P. *See* Green, Arthur G.

Kaufmann, W. *See* Curie, Mme. S.

Kaul, Hermann. *See* Bischof, Carl.

Kebler, Syman F. Adulterated drugs and chemicals. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 80.) Washington 1904.

Kekulé, August. Über die Konstitution und die Metamorphosen der chemischen Verbindungen und über die chemische Natur des Kohlenstoffs. Untersuchungen über aromatische Verbindungen. Herausgegeben von A. Ladenburg. (Ostwald's *Klassiker*, No. 145.) Leipzig 1904.

Kepler, Johannes. Dioptrik oder Schilderung der Folgen, die sich aus der unlängst gemachten Erfindung der Fernrohre für das Sehen und die sichtbaren Gegenstände ergeben, 1611. Herausgegeben von Ferdinand Plehn. (Ostwald's *Klassiker*, No. 144.) Leipzig 1904.

Kobert, Rudolf. Lehrbuch der Intoxikationen. Band II, 1 Hälfte. Zweite Auflage. pp. 400. ill. Stuttgart 1904.

König, J. Chemie der menschlichen Nahrungs- und Genussmittel. Band II. Die menschlichen Nahrungs- und Genussmittel, ihre Herstellung, Zusammensetzung und Beschaffenheit, nebst einem Abriss über die Ernährungslehre. Vierte Auflage. pp. xxv + 1557. ill. Berlin 1904.

Kohlrausch, Friedrich. *See* Weber, Wilhelm.

Kohlrausch, Rudolf. *See* Weber, Wilhelm.

Kremers, Edward. *See* Gildemeister, Eduard.

Kühling, O. *See* Heumann, Karl.

Kunz, George F., and Baskerville, Charles. The action of radium, actinium, Roentgen rays, and ultra-violet light on minerals and gems. (From *Science*, N.S., 18, 1903.)

Kunz, George F. *See* Baskerville, Charles.

Kyōto Imperial University. Memoirs of the College of Science and Engineering. Vol. I, No. 1. 1903.

Ladenburg, A. *See* Kekulé, August.

Lafar, Franz. Handbuch der technischen Mykologie. Zweite Auflage. Erste Lieferung. ill. Jena 1904.

Langworthy, C. F., and Austen, Peter T. The occurrence of aluminium in vegetable products, animal products, and natural waters. A contribution to the bibliography of the subject. pp. 168. New York 1904.

Lassar-Cohn. Allgemeine Gesichtspunkte für organisch-chemisches Arbeiten. pp. 79. Hamburg 1904.

Leach, Albert E. Food inspection and analysis. For the use of public analysts, health officers, sanitary chemists, and food economists. pp. xiv + 787. ill. New York 1904.

Lehne, A. *See* Noelting, E.

Lenglen, M. *See* Robine, R.

Lewkowitsch, J. Cantor lectures on oils and fats: their uses and applications. pp. 52. ill. London 1904.

—— Chemical technology and analysis of oils, fats, and waxes. Third edition. pp. 1152. ill. 2 vols. London 1904.

Lippmann, Edmund O. von. Die Chemie der Zuckerarten. 3rd edition of *Die Zuckerarten und ihre Derivate*. 2 vols. pp. 2003. Braunschweig 1904.

Liversidge, A. Tables for qualitative chemical analysis. Second edition. pp. 126. London 1904.

Local Government Board. Reports . . . on the destruction of rats and disinfection on shipboard. By J. S. Haldane and John Wade. pp. 28. ill. London 1904.

Lodge, Richard W. Notes on assaying, and metallurgical laboratory experiments. pp. viii + 287. ill. New York 1904.

Loewy, Alfred. *See* Sturm, C.

Long, J. H. The electrical conductivity of urine in relation to its chemical composition. Part II. The conductivity of mixed solutions. (From the *J. Amer. Chem. Soc*, **26**, 1904.)

Ludwig, A. *See* Caro, N.

Lunge, George. A theoretical and practical treatise on the manufacture of sulphuric acid and alkali, with the collateral branches. Vol. I. Sulphuric Acid. pp. xxvii + 1214. ill. 2 vols. London 1903.

Lunge, Georg. *See* Chemisch-technische Untersuchungsmethoden.

Maclaurin, J. S. *See* New Zealand, Mines Department.

Maercker, Max. Handbuch der Spiritusfabrikation. Achte, voll-

ständig neubearbeitete Auflage, herausg. von Max Delbrück. pp. xx + 940. ill. Berlin 1903.

Manchester, Rivers Department. Annual Report, year ending March 30th, 1904. pp. 44.

Mandel, John A. *See* Arnold, Carl.

Mann, J. Dixon. Forensic medicine and toxicology. 3rd edition, revised and enlarged. pp. 692. ill. London 1902.

Marshall, Hugh. *See* Dobbin, Leonard.

Meldola, Raphael. The chemical synthesis of vital products and the inter-relations between organic compounds. Vol. I. Hydrocarbons, alcohols and phenols, aldehydes, ketones, carbohydrates and glucosides, sulphur and cyanogen compounds, camphor and terpenes, colouring-matters of the flavone group. pp. xvi + 339. London 1904.

Merrill, Elmer D. A dictionary of the plant names of the Philippine Islands. pp. 193. Manila 1903.

Mez, Carl. *See* Hager, Hermann.

Möller, Joh. Die elektrochemische Reduktion der Nitroderivate organischer Verbindungen in experimenteller und theoretischer Beziehung. pp. 113 + vii. Halle 1904.

Moissan, Henri. *See* Traité de chimie minérale.

Mojonnier, Timothy. *See* Grindley, H. S.

Morse, Irving H. Calculations used in cane-sugar factories. A practical system of chemical control for Louisiana sugar-houses and other cane-producing countries. pp. viii + 75. New York 1904.

Muir, M. M. Pattison. The elements of chemistry. pp. 554. ill. London 1904.

Munson, L. S. *See* Chace, Ed. Mackay.

—— *See* Tolman, L. M.

Muter, John. A short manual of analytical chemistry, qualitative and quantitative—inorganic and organic. Following the course of instruction given in the laboratories of the South London School of Pharmacy. 9th ed. pp. xiv + 235. ill. London 1903.

Nernst, Walther. Theoretische Chemie vom Standpunkte der Avogadroschen Regel und der Thermodynamik. 4 Aufl. pp. xiv + 749. ill. Stuttgart 1903.

Newman, George. *See* Swithinbank, Harold.

New South Wales. Department of Mines and Agriculture. Memoirs of the Geological Survey. Geology, No. 3. The kerosene shale deposits of N.S.W.; with maps, plates, and sections. By J. E. Carne. pp. 333. Sydney 1903.

New York Agricultural Experimental Station. Directors' Report for 1903. (Bulletin No. 244.)

New Zealand, Mines Department. Thirty-seventh annual report

of the Colonial Laboratory. By J. S. Maclaurin. pp. 30. Wellington 1904.

Nicholson, J. F. *See* Harding, H. A.

Noelting, E., und Lehne, A. Anilinschwarz und seine Anwendung in Färberei und Zeugdruck. Zweite Auflage. pp. 178. ill. Berlin 1904.

Oppenheimer, Carl. Die Fermente und ihre Wirkungen. 2 Aufl. pp. viii + 440. Leipzig 1903.

Ostwald, Wilhelm. Abhandlungen und Vorträge, 1887—1903. pp. x + 468. Leipzig 1904.

—— Grundlinien der anorganischen Chemie. Zweite Auflage. pp. xx + 808. ill. Leipzig 1904.

—— Malerbriefe, Beiträge zur Theorie und Praxis der Malerei. pp. viii + 165. Leipzig 1904.

—— *See* Walden, P.

Ostwald's Klassiker der Exakten Wissenschaften. *See* Kekulé, A.; Kepler, J.; Sturm, C.; and Weber, W.

Page, Logan Waller, and Cushman, Allerton S. The testing of road materials. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 79). Washington 1904.

Patten, A. J., and Hart, E. B. The nature of the principal phosphorus compound in wheat bran. (New York Agric. Exper. Station, Bulletin No. 250, 1903.)

Perrot, Em. *See* Collin, Eugene.

Peterson-Kinberg, Willy. Wie eine moderne Teerdestillation mit Dachpappenfabrik eingerichtet sein muss. pp. viii + 224. ill. Wien und Leipzig 1904.

Pictet, Amé. The vegetable alkaloids. With particular reference to their chemical constitution. From the second French edition, rendered into English, revised and enlarged by H. C. Biddle. pp. 505. New York 1904.

Plehn, Ferdinand. *See* Kepler, Johannes.

Plücker, J. *See* Hittorf, J. W.

Richards, Joseph W. *See* Engelhardt, Viktor.

Richards, Theodore William, and Stull, Wilfred Newsome. New method for determining compressibility. pp. 45. ill. Washington 1903.

Richardson, Clifford. The constitution of Portland cement from a physico-chemical standpoint. pp. 20. New York 1904.

Riggs, Louis Warner. Elementary manual for the chemical laboratory. pp. 138. New York 1904.

Robine, R., et Lenglen, M. L'industrie des cyanures. Étude théorique et industrielle. pp. 463. ill. Paris 1903.

Roozeboom, H. W. Bakhuis. Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Heft 1. Die Phasenlehre—Systeme aus einer Komponente. Heft 2. i. Systeme aus zwei Komponenten. pp. xiii + 221, xii + 467. ill. Braunschweig 1901—1904.

Rostoski, O. Manual of serum diagnosis. Authorised translation by Charles Bolduan. pp. 86. ill. New York 1904.

Royal Commission on Arsenical Poisoning. Reports of the Royal Commission appointed to inquire into arsenical poisoning from the consumption of beer and other articles of food and drink. 4 vols London 1901—1903.

Royal Society of London. Record. Second edition, 1901. pp. 427.

Schelenz, Hermann. Geschichte der Pharmazie. pp. xi + 935. Berlin 1904.

Schmatolla, Otto. Neue Entdeckungen aus dem Gebiete der Chemie und Physik. Die unbegrenzte Teilbarkeit der Masse, der Aufbau der Körper. pp. 84. Berlin 1904.

Schmidt, G. C. Die Kathodenstrahlen. pp. 120. ill. Braunschweig 1904.

Schmidt, Julius. Über die basischen Eigenschaften des Sauerstoffs und Kohlenstoffs. pp. 111. Berlin 1904.

Schultz, G. *See* Green, A. G.

Science Abstracts. Physics and electrical engineering. Issued under the direction of the Institution of Electrical Engineers and the Physical Society of London. Vol. I, 1898, edited by J. Swinburne. Vol. II—IV, 1899—1901, by W. R. Cooper. Vol. V, 1902, by G. W. de Tunzelmann. After Vol. VI, 1903, published in two classes: (A.) Physics. (B.) Electrical Engineering. London 1898 +

Seger, Hermann August. Gesammelte Schriften. Herausgegeben von H. Hecht und F. Cramer. pp. xv + 908. Berlin 1896.

Senier, Alfred. On acridines. Abstract of a paper read before the British Association, Southport meeting, 1903. (From the *Chemical News*, **88**, 1903.)

Sherman, P. L. The gutta-percha and rubber of the Philippine Islands. pp. 43. ill. Manila 1903.

Siebert, G. *See* Thomson, J. J.

Sodeau, William H. The decomposition of chlorates. (From the *Proc. Univ. of Durham Phil. Soc.*, **2**, 1903.)

—— The estimation of unburnt products in chimney gases by means of a modified Orsat apparatus. (From the *Chem. News*, **89**, 1904.)

Spaeth, Eduard. Die chemische und mikroskopische Untersuchung des Harnes. pp. xx + 532. ill. Leipzig 1903.

Stark, Johannes. *See* Jahrbuch der Radioaktivität.

Stoddart, F. Wallis. On the best method of sewage disposal for small communities. pp. 32. ill. Bristol 1904.

Stolper, P. *See* Hager, Hermann.

Storer, F. H. A supplement to the article (No. 3) on the occurrence of mannan in trees, roots, and fruit. (From the *Bulletin of the Bussey Institution*, 3, 1904.)

Stull, Wilfred Newsome. *See* Richards, Theodore William.

Sturm, C. Abhandlung über die Auflösung der numerischen Gleichungen, 1835. Herausgegeben von Alfred Loewy. (Ostwald's *Klassiker*, No. 143.) Leipzig 1904.

Sutton, Francis. Systematic handbook of volumetric analysis. Ninth edition. pp. xii + 617. ill. London 1904.

Swithinbank, Harold, and Newman, George. Bacteriology of milk. With special chapters on the spread of disease by milk and the control of the milk supply. pp. xx + 605. ill. London 1903.

Tammann, Gustav. Kristallisieren und Schmelzen. Ein Beitrag zur Lehre der Änderungen des Aggregatzustandes. pp. x + 348. ill. Leipzig 1903.

Taylor, O. M. *See* Beach, S. A.

Thomson, J. J. Elektrizität und Materie. Autorisierte Übersetzung von G. Siebert. pp. 100. Braunschweig 1904.

Tolman, L. M., and Munson, L. S. Olive oil and its substitutes. (U.S. Dept. of Agric. Bureau of Chemistry Bulletin, No. 77.) Washington 1904.

Tolman, L. M. *See* Chace, Ed. Mackay.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome I. Métalloïdes. Tome III. Métaux. pp. xiii + 857, v + 1078. ill. Paris 1904.

Travers, Morris W. Researches on the attainment of very low temperatures. (From the *Smithsonian Miscellaneous Collections*, 46, 1904.)

Treadwell, F. P. Analytical chemistry. Volume II. Quantitative analysis. Translated by William T. Hall. pp. 654. ill. New York 1904.

Turrentine, J. W. *See* Baskerville, Charles.

Ulzer, Ferdinand. *See* Benedikt, Rudolf.

United States, Philippine Commission. Report of the Superintendent of Government Laboratories in the Philippine Islands, for the year ended September 1st, 1903. pp. 278. ill. 1904.

University of California. Report of work of the Agricultural Experiment Station of the University of California. 1901—1903. pp. 222. ill.

Valenta, E. *See* Eder, J. M.

Vogel, J. H. *See* Caro, N.

Wachter, Wilhelm. Das Feuer in der Natur, im Kultus und Mythus, im Völkerleben. pp. 166. Leipzig 1904.

Wade, John. *See* Local Government Board.

Walden, P. Wilhelm Ostwald. pp. 120. ill. Leipzig 1904.

Walker, A. Jamieson. *See* Holleman, A. F.

Walker, James. Introduction to physical chemistry. 3rd ed. pp. 368. ill. London 1903.

Wallace, Robert. Argentine shows and live stock. pp. 154. ill. Edinburgh 1904.

Warner, H. J. *See* Haywood, J. K.

Wassermann, A. Immune sera: hæmolysins, cytotoxins, and precipitins. Authorised translation by Charles Bolduan. pp. 77. ill. New York 1904.

Weber, Wilhelm, und Kohlrausch, Rudolf. Fünf Abhandlungen über Absolute elektrische Strom- und Widerstandsmessung. Herausgegeben von Friedrich Kohlrausch. (Ostwald's *Klassiker*, No. 142). Leipzig 1904.

Weissberg, J. *See* Engler, C.

Werner, A. Lehrbuch der Stereochemie. pp. xvi + 474. ill. Jena 1904.

West Indies, Imperial Department of Agriculture. Sugar-cane experiments in the Leeward Islands. Part I. Experiments with varieties of sugar-cane, with appendices on the chemical selection of sugar-cane. Part II. Manurial experiments. pp. 68, 115. Barbados 1904.

Wiley, Harvey W. The influence of environment upon the composition of the sugar beet, 1902, including a study of irrigated sections. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 78.) Washington 1904.

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ERRATUM.

No. 274, p. 1, *for* "Vol. 19" *read* "Vol. 20."

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/1/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20 No. 274.

Wednesday, January 20th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. U. O. S. Nairne and J. T. Hali were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

J. P. Ackroyd, B.Sc., 116, Richmond Street, Accrington, Lancs.
Charles Thomas Bennett, 57, Larkhall Rise, Clapham, S.W.
George E. P. Broderick, B.Sc., Lampeter, S. Wales.
Julian Drugman, Ph.D., La Bocca, Cannes, France.
George Fry, Carlin Brae, Berwick-on-Tweed.
Francis D'Oyley Mears, jun., 4, Nyanza Terrace, Swansea.
Jatindranâth Sen, M.A., 71, Cathedral Mission Lane, Calcutta.
Raymond Louis Siau, 15, Merridale Lane, Wolverhampton.
Henry E. Stevenson, Avondale, Ditton Hill, Surrey.
Charles H. Thompson, Hillcroft, Amblecote, Stourbridge.

Hubert Thompson, B.Sc., Holmes Chapel, Cheshire.
Léon Edward Walling, 43, Union Road, Rotherhithe.
Charles Edward Whiteley, 9, Abyssinia Grove, Leeds.
William Henry Woodcock, 10, Chesson Road, W. Kensington, W.

Certificates in favour of the following were authorised by the Council for presentation for Ballot under Bye-Law I (3):

Anu Ghose, 42, Shambazar Street, Calcutta.
J. P. Montgomery, Agricultural College, Starkville, Miss., U.S.A.

The PRESIDENT announced that since the last meeting of the Society the Rev. T. J. Prout, M.A., F.G.S., Senior Student of Christ Church, Oxford, had presented to the Society a photograph of a portrait by Hayes of his father, Dr. William Prout, F.R.S., which was considered to be a very good likeness of the author of the famous paper "On the Relation between the Specific Gravities of Bodies in their Gaseous State and the Weights of their Atoms," published anonymously in Thomson's *Annals of Philosophy* in November, 1815.

The Council has ordered the following report to be printed in the Journal and in the Proceedings of the Society:

Report of the International Committee on Atomic Weights.

The International Committee on Atomic Weights * has the honour to offer the following report:

In the table of atomic weights for 1904, only two changes from 1903 are recommended. The atomic weight of cæsium has been slightly modified to accord with the recent determinations by Richards and Archibald, and that of cerium in conformity with the measurements by Brauner. The value for lanthanum is still in controversy, and any change here would therefore be premature. The same consideration may also be urged with regard to iodine. Ladenburg has shown that the accepted number for iodine is probably too low, but other investigations upon the subject are known to be in progress, and until they have been completed it would be unwise to propose any alteration.

Many of the atomic weights given in the table are well known to be

* The original members of the Committee take great pleasure in announcing the addition to their number of Professor Henri Moissan. They are confident that this increase will meet with universal approval.

more or less uncertain. This is especially true with respect to the rarer elements, such as gallium, indium, columbium, tantalum, &c. But some of the commoner elements also stand in need of revision, and we venture to call attention to a few of these. Among the metals, the atomic weights of mercury, tin, bismuth, and antimony should be redetermined, for the reason that the existing data are not sufficiently concordant. Palladium also, on account of discrepancies between different observers, and possibly vanadium, for which the data are too few, deserve some attention. Among the non-metals, phosphorus has been peculiarly neglected, and our knowledge of the atomic weight of silicon rests upon a single ratio. In the latter case, confirmatory data are much to be desired. Upon any of these elements, new investigations would be most serviceable.

There is one other point to which we may properly call attention. Many of the ratios from which atomic weights have been calculated were measured in vessels of glass, by processes involving the use of strong acids. In such cases, the solubility of the glass becomes an important consideration, even when no transfer of material from one vessel to another has occurred. A slight conversion of silicate into chloride would cause an increase of weight during the operation, and so introduce an error into the determination. Such errors are doubtless very small, but still they ought not to be neglected. Now that vessels of pure silica, the so-called quartz-glass, are available for use, they might well replace ordinary glass in all processes for the determination of atomic weights. An investigation into the relative availability of the two kinds of glass is most desirable.

F. W. Clarke
T. E. Thorpe
K. Seubert
Henri Moissan
} *Committee.*

1904.

International Atomic Weights.

		O=16.	H=1.
Aluminium	Al	27·1	26·9
Antimony	Sb	120·2	119·3
Argon	A	39·9	39·6
Arsenic	As	75·0	74·4
Barium	Ba	137·4	136·4
Bismuth	Bi	208·5	206·9
Boron	B	11	10·9
Bromine	Br	79·96	79·36
Cadmium	Cd	112·4	111·6
Cæsium	Cs	132·9	131·9
Calcium	Ca	40·1	39·8
Carbon	C	12·00	11·91
Cerium	Ce	140·25	139·2
Chlorine	Cl	35·45	35·18
Chromium	Cr	52·1	51·7
Cobalt	Co	59·0	58·56
Columbium	Cb	94	93·3
Copper	Cu	63·6	63·1
Erbium	Er	166	164·8
Fluorine	F	19	18·9
Gadolinium	Gd	156	155
Gallium	Ga	70	69·5
Germanium	Ge	72·5	71·9
Glucinum	Gl	9·1	9·03
Gold	Au	197·2	195·7
Helium	He	4	4
Hydrogen	H	1·008	1·000
Indium	In	114	113·1
Iodine	I	126·85	125·90
Iridium	Ir	193·0	191·5
Iron	Fe	55·9	55·5
Krypton	Kr	81·8	81·2
Lanthanum	La	138·9	137·9
Lead	Pb	206·9	205·35
Lithium	Li	7·03	6·98
Magnesium	Mg	24·36	24·18
Manganese	Mn	55·0	54·6
Mercury	Hg	200·0	198·5
Molybdenum	Mo	96·0	95·3
Neodymium	Nd	143·6	142·5
Neon	Ne	20	19·9
Nickel	Ni	58·7	58·3
Nitrogen	N	14·04	13·93
Osmium	Os	191	189·6
Oxygen	O	16·00	15·88
Palladium	Pd	106·5	105·7
Phosphorus	P	31·0	30·77
Platinum	Pt	194·8	193·3
Potassium	K	39·15	38·86
Praseodymium	Pr	140·5	139·4
Radium	Rd	225	223·3
Rhodium	Rh	103·0	102·2
Rubidium	Rb	85·4	84·8
Ruthenium	Ru	101·7	100·9
Samarium	Sm	150	148·9
Scandium	Sc	44·1	43·8
Selenium	Se	79·2	78·6
Silicon	Si	28·4	28·2
Silver	Ag	107·93	107·12
Sodium	Na	23·05	22·88
Strontium	Sr	87·6	86·94
Sulphur	S	32·06	31·83
Tantalum	Ta	183	181·6
Tellurium	Te	127·6	126·6
Terbium	Tb	160	158·8
Thallium	Tl	204·1	202·6
Thorium	Th	232·5	230·8
Thulium	Tm	171	169·7
Tin	Sn	119·0	118·1
Titanium	Ti	48·1	47·7
Tungsten	W	184	182·6
Uranium	U	238·5	236·7
Vanadium	V	51·2	50·8
Xenon	Xe	128	127
Ytterbium	Yb	173·0	171·7
Yttrium	Yt	89·0	88·3
Zinc	Zn	65·4	64·9
Zirconium	Zr	90·6	89·9

Of the following papers, those marked * were read :

*1. "The chemical reactions of nickel carbonyl. Part I. Reactions with the halogens and other inorganic substances." By James Dewar and Humphrey Owen Jones.

The previous study of the physical properties of nickel carbonyl (*Proc. Roy. Soc.*, 1903, 71, 627) showed that it was a comparatively stable substance when heated under pressure. The authors have undertaken the investigation of its chemical behaviour mainly from a thermochemical standpoint, with the view of studying its constitution and its possible use as a synthetical agent.

Nickel carbonyl is completely decomposed by solutions of chlorine, bromine, iodine, cyanogen, and sulphur in organic solvents, carbon monoxide and a nickel compound being produced; in no case was any combination of the carbon monoxide with the halogen or other reagent observed, even when a considerable excess of the latter was present.

From Mittasch's value (52·2 Cal.) for the heat of formation of nickel carbonyl and Thomsen's values for nickel compounds, it was to be expected that chlorine and bromine would decompose it readily, but that iodine, cyanogen, and sulphur would not. In the case of iodine, the heat necessary to carry out the reaction appears to be obtained by the formation of molecular complexes of nickel iodide and the solvent (for example, ether and chloroform), and in the case of sulphur by the formation of a higher sulphide, probably Ni_2S_3. Liquid chlorine and bromine decompose solid nickel carbonyl, but solid iodine appears to have no action on liquid nickel carbonyl.

Iodine mono- and tri-chlorides and cyanogen iodide in carbon tetrachloride solution react with nickel carbonyl in two distinct stages, the free iodine liberated at first subsequently decomposing a further quantity of nickel carbonyl.

Hydrogen iodide readily interacts with nickel carbonyl, whereas the corresponding bromide and chloride do not affect it.

Hydrogen sulphide reacts very slowly with nickel carbonyl, producing nickel monosulphide, hydrogen, and carbon monoxide. Sulphuric acid also decomposes the compound slowly, giving rise to nickel sulphate, hydrogen, and carbon monoxide.

***2. "The chemical reactions of nickel carbonyl. Part II. Reaction with aromatic hydrocarbons in presence of aluminium chloride. Synthesis of aldehydes and anthracene derivatives." By James Dewar and Humphrey Owen Jones.**

Nickel carbonyl does not react with either aluminium chloride or benzene separately, but with a mixture of the two substances, a violent reaction begins immediately and torrents of hydrochloric acid are evolved. The reaction with various benzene homologues has been investigated both at the ordinary temperature and also at 100°.

From benzene at the ordinary temperature, benzaldehyde is produced together with traces of oils having high boiling points. At 100°, the quantity of benzaldehyde is much smaller, and anthracene, which is now the chief product, is produced in considerable quantities. The mechanism of this production of anthracene from benzaldehyde has not been elucidated, but the reduction is probably due to the action of the nickel produced by the decomposition of the nickel carbonyl.

Toluene gives *p*-tolualdehyde and 2 : 6-dimethylanthracene (m. p. 215—216°). *m*-Xylene similarly yields 2 : 4-dimethylbenzaldehyde and a tetramethylanthracene melting at 280°, which is in all probability 1 : 3 : 5 : 7-tetramethylanthracene. Mesitylene yields an aldehyde only, condensation to an anthracene derivative being in this case impossible.

Naphthalene behaves in an entirely different way; no aldehyde is formed either in the cold or at 100°, and a hydrocarbon, $C_{16}H_{12}$, is produced together with oily or resinous substances having very high boiling points, which appear to be further condensation products, since the quantity produced is much greater at the higher temperature. This hydrocarbon, which melts at 180—181°, is probably identical with that obtained by Bischoff by the interaction of naphthalene and methyl chloride in the presence of aluminium chloride, and may also be identical with that produced from ruficoccine or coccinine by distillation with zinc dust.

***3. "Optically active asymmetric nitrogen compounds. *d*- and *l*-Phenylbenzylmethylethylammonium salts." By Humphrey Owen Jones.**

The resolution of the phenylbenzylmethylethylammonium salts was undertaken with the view of showing that optical activity in nitrogen compounds was independent of the existence of isomerides of the compound in question.

The only optically active nitrogen compounds known at present are the *d*- and *l*-α-phenylbenzylmethylallylammonium salts, and these are also the only quinquevalent nitrogen compounds (not containing an asymmetric carbon atom) which have been shown to exist in definite stable isomeric forms.

Phenylbenzylmethylethylammonium iodide has been prepared in the three possible ways, namely, by the following combinations: (1) methylethylaniline and benzyl iodide, (2) benzylethylaniline and methyl iodide, (3) benzylmethylaniline and ethyl iodide. The velocity of formation of the iodide is remarkably different in the three cases, that in the first combination being the greatest and that in the third being the least. The compound produced, which is the same in all three cases, crystallises from alcohol in lustrous, prismatic prisms, the melting point of which is about 140—142°, but this is to a certain extent dependent on the rate of heating.

The iodide was converted into the *d*- and *l*-camphorsulphonates by boiling molecular proportions of the salt and silver *d*- and *l*-camphorsulphonates with ethyl acetate and a small quantity of alcohol.

The camphorsulphonate was crystallised repeatedly from a mixture of dry ethyl acetate and ethylal at a comparatively low temperature until its rotatory power was constant. *d*-Phenylbenzylmethylethylammonium *d*-camphorsulphonate crystallises in lustrous prisms melting at 180—181°. It is very sparingly soluble in ethyl acetate and acetone and has $[M]_D = 71{\cdot}0°$ in aqueous solution.

The corresponding *ll*-salt is identical with its *dd*-isomeride in appearance and properties and has $[M]_D = -71{\cdot}2°$. *d*-Phenylbenzylmethylethylammonium iodide, which was obtained by mixing the calculated quantities of potassium iodide and the *d*-camphorsulphonate in aqueous solution, has the same appearance, crystalline form, and melting point as the inactive iodide; it is very sparingly soluble in alcohol and other solvents. Its rotatory power is small, so that determinations of this constant are difficult, the observed $[M]_D$ being about 30°. The corresponding *l*-iodide, which was prepared from the *l*-camphorsulphonate in a similar manner, had $[M]_D = 30°$ (approximately). The iodides undergo racemisation in chloroform solution, but their molecular weight in this solvent appears to be nearly normal at the ordinary temperature.

The inactive and lævorotatory bromides were also prepared and were found to melt at 155—156°. The latter compound has a higher specific rotatory power than the *l*-iodide.

The feeble rotatory power of these salts compared with that of the active α-phenylbenzylmethylallylammonium salts is remarkable, since the only difference is the replacement of an allyl by an ethyl radicle.

*4. "A microscopic method of determining molecular weights." By George Barger.

The author has continued the experiments of which a preliminary account has already been given (Proc., 1903, 19, 121). The method is based on the comparison of the vapour pressures of two solutions, of which biconcave, lenticular drops are placed in a capillary tube. A difference in the vapour pressures causes a mutual variation in the size of the drops, which is observed by means of an eye-piece micrometer.

About one hundred determinations with various substances in eleven different solvents have now been made, and the experimental error is found to vary from 5 to 10 per cent. Solvents of widely differing boiling points have been employed, including ether, xylene, and light petroleum (b. p. 50—60°). Some determinations were performed with minute quantities of the dissolved substance.

The method is being applied to the study of association in mixtures of associative and non-associative solvents. The behaviour of benzoic acid in mixtures of benzene and ethyl alcohol, and of cinnamic acid in mixtures of chloroform and methyl alcohol has so far been studied, the results showing that a small proportion of the alcohol suffices to give these acids a normal molecular weight. Should this phenomenon prove to be general, it would be of practical value in determining molecular weights in those cases where associative solvents only can be employed.

Discussion.

Dr. Philip asked whether it would be possible to carry out the experiments at a higher temperature, nearer the boiling point of the solvent, in order to shorten the time necessary for the establishment of equilibrium between the drops.

Dr. Hewitt suggested the possibility of using two graduated tubes fitted with tightly-fitting india-rubber stoppers and connected by a T-tube, the third branch of which should have a stop-cock. Into one of the graduated tubes a standard solution could be introduced, and into the other a weighed quantity of the substance, together with some of the solvent. It would then only be necessary to exhaust the apparatus, place it in a bath until equilibrium was attained, allow to cool, and measure the respective volumes of solution in the two graduated tubes.

Mr. Barger, in reply to Dr. Philip, said that the tubes must either be measured at the higher temperature or cooled down to that of the microscope. In the latter case, the solvent condenses between the

drops on the walls of the tube, and thus produces an error. In the former case, it has not been found possible to prevent the condensation of water vapour on the frontal lens of the microscope objective.

Macroscopic methods similar to that suggested by Dr. Hewitt have been tried, both volumetrically and gravimetrically, but without the least success. The essential conditions which make the present method possible are:

(1) The accuracy with which extremely small changes in volume of the drops can be detected under the microscope.

(2) The large evaporating surface presented by the drops, as compared with their volume.

***5. "Studies in the acridine series. Part I." By John Jacob Fox and John Theodore Hewitt.**

The authors find that 6-acetamino-2 : 7-dimethylacridine (m. p. 270° uncorr., Ullmann gives 258°, *Ber.*, 1903, **36**, 1025) unites with methyl iodide to form a quaternary acridinium iodide, a substance yielding a precipitate with ammonia. The isolation of the corresponding carbinol seems impracticable on account of the ease with which the acetyl group is hydrolysed. To ensure complete hydrolysis, the solution obtained on boiling the precipitate with dilute sulphuric acid is treated with ammonia, when the base is liberated. This compound, which, when crystallised from acetone, has a pale red colour, melts at 210° (uncorr.) and corresponds with the formula $C_{16}H_{18}ON_2$; it is probably a carbinol having the following constitution:

$$C_6H_3Me\begin{<}NMe\\CH(OH)\end{>}C_6H_2Me{\cdot}NH_2.$$

When the carbinol base is heated for some hours at 184°, partial dehydration occurs, and on warming the nitrobenzene solution of the substance, a very appreciable evolution of water is observed. On filtering the hot solution and subsequently treating the cooled filtrate with light petroleum, a dark red compound, $C_{16}H_{14}N_2$, is deposited, which is readily soluble in acids and probably has the constitution $C_6H_3Me\begin{<}NMe\\CH\end{>}C_6H_2Me{:}NH$, because the oxygen removed as water was attached in the carbinol base to the carbon atom of the median ring. Such a formula for the anhydrobase agrees with the constitution $C_6H_4\begin{<}NPh\\N\end{>}C_6H_3{\cdot}NH$, for the base of aposafranine, and does not correspond with the aposafranine formula suggested by Kehrmann (compare *Ber.*, 1896, **29**, 2316; *Annalen*, 1896, **290**, 256).

6. "*o*-Nitrobenzoylacetic acid." By Edward Rushton Needham and William Henry Perkin, jun.

Ethyl sodioacetoacetate (2 mols.) reacts readily with *o*-nitrobenzoyl chloride (1 mol.), yielding the sodium compound of ethyl *o*-nitrobenzoylacetoacetate, $NO_2 \cdot C_6H_4 \cdot CO \cdot CAcNa \cdot CO_2Et$ (Gevekoth, *Annalen*, 1883, 221, 323), and when this product is digested with ammonia and ammonium chloride (compare Claisen, *Annalen*, 1896, 291, 67) the acetyl group is eliminated and *ethyl o-nitrobenzoylacetate*,

$$NO_2 \cdot C_6H_4 \cdot CO \cdot CH_2 \cdot CO_2Et,$$

is produced. This ester is a pale brown oil which, in alcoholic solution, gives an orange-red coloration with ferric chloride; it readily dissolves in dilute aqueous caustic potash yielding a yellow, crystalline *potassium* derivative, $NO_2 \cdot C_6H_4 \cdot CO \cdot CHK \cdot CO_2Et$, and when its ethereal solution is shaken with ammoniacal copper sulphate, the green, crystalline *copper* derivative, $NO_2 \cdot C_6H_4 \cdot CO \cdot CH \cdot Cu_{\frac{1}{2}} \cdot CO_2Et$, is obtained. Ethyl *o*-nitrobenzoylacetate dissolves in concentrated sulphuric acid, and if the solution is heated at 90° for a few minutes and then poured into water, *o-nitrobenzoylacetic acid*,

$$NO_2 \cdot C_6H_4 \cdot CO \cdot CH_2 \cdot CO_2H,$$

separates, and may be purified by crystallisation from water. It melts at about 118°, and, when boiled with water, is decomposed into *o*-nitroacetophenone and carbon dioxide.

7. "The *cis*- and *trans*-modifications of *aaγ*-trimethylglutaconic acid." By William Henry Perkin, jun., and Alice Emily Smith.

The authors have already shown (Trans., 1903, 83, 772) that when ethyl *aaγ*-trimethylacetonedicarboxylate,

$$CO_2Et \cdot CMe_2 \cdot CO \cdot CHMe \cdot CO_2Et,$$

is reduced with sodium amalgam, it is converted into a mixture of the *cis*- and *trans*-modifications of *β*-hydroxy-*aaγ*-trimethylglutaric acid, $CO_2H \cdot CMe_2 \cdot CH(OH) \cdot CHMe \cdot CO_2H$, and both of these, by treatment first with phosphorus pentachloride and then with diethylaniline, yield *trans-aaγ*-trimethylglutaconic acid, $CO_2H \cdot CMe_2 \cdot CH{:}CMe \cdot CO_2H$, which melts at 150°. They now show that on distillation both of the foregoing hydroxy-acids are converted into the anhydride of the *cis*-modification of *aaγ-trimethylglutaconic acid*, which melts at 88°, and on hydrolysis yields the corresponding acid melting at about 125°. On treatment with bromine, *cis*-trimethylglutaconic acid yields cis-*βγ-dibromo-aaγ-trimethylglutaric acid*, $CO_2H \cdot CMe_2 \cdot CHBr \cdot CMeBr \cdot CO_2H$, which melts at 168°.

During the distillation of the hydroxy-acids, a considerable amount

of carbon dioxide and steam is eliminated, and an oily acid is produced which distils at 213°. This substance, *crotonyldimethylacetic acid*, $CO_2H{\cdot}CMe_2{\cdot}CH{:}CHMe$, when treated with bromine, yields the lactone of β-bromo-γ-hydroxy-αaγ-trimethylbutyric acid (m. p. 83°),

$$\begin{matrix} CMe_2{\cdot}CHBr{\cdot}CHMe \\ | \\ CO\text{———}O \end{matrix},$$

and, when boiled with dilute sulphuric acid, is converted into the lactone of γ-hydroxy-αaγ-trimethylbutyric acid (α-dimethylvalerolactone), $\begin{matrix} CMe_2{\cdot}CH_2{\cdot}CHMe \\ | \\ CO\text{———}O \end{matrix}$, which melts at 52° and has already been described by Anschütz and Gillet (*Annalen*, 1888, 247, 107), who obtained it by the reduction of αa-dimethyllævulic acid,

$$CO_2H{\cdot}CMe_2{\cdot}CH_2{\cdot}COMe.$$

8. "**The influence of substitution in the nucleus on the rate of oxidation of the side-chain. I. Oxidation of the mono- and dichlorotoluenes.**" **By Julius Berend Cohen and James Miller.**

The method of oxidation adopted was to heat about a gram of each of the isomerides with dilute nitric acid in a sealed tube for a length of time insufficient for complete oxidation and to estimate the proportion of the acid product and the unchanged substance. The vessel employed as air-bath was a jacketed, tin-plate cylinder containing boiling coal-tar naphtha and furnished with a condenser, the tubes being heated in the inner compartment, which was kept at a nearly constant temperature.

The results of several series of experiments show that the monohalogen derivatives are more rapidly attacked than the dihalogen compounds. Of the three monochlorotoluenes, the meta-compound is least rapidly and the para-isomeride most rapidly oxidised. Of the dihalogen compounds, the 3 : 5-compound is least affected; then follow the 2 : 5- and 2 : 6-isomerides, which are oxidised about equally; then the 2 : 3-compound, and finally the 2 : 4- and 3 : 4-compounds, which may be bracketed together as being most readily attacked.

So far as these experiments are concerned, in which the oxidising agent is nitric acid, the results are perfectly definite. The meta-compounds retard and the para-derivatives assist oxidation, whilst the ortho-compounds occupy an intermediate position.

Thus, *m*-chlorotoluene and 3 : 5-dichlorotoluene are least attacked by the acid, whereas *p*-chlorotoluene and the 2 : 4- and 3 : 4-dichlorotoluenes, which each contain a chlorine atom in the para-position with respect to the methyl group, are most rapidly oxidised.

9. "The interdependence of the physical and chemical criteria in the analysis of butter fat." By Thomas Edward Thorpe.

In the course of an investigation on the chemical nature of butter produced within the British Isles, which was instituted by the Board of Agriculture for the information of a Departmental Committee appointed to report as to what regulations might with advantage be made for determining what deficiency in any of the normal constituents of butter should raise a presumption under the Food and Drugs Acts that the butter was not genuine, it became necessary to obtain at first-hand the values of butter of known origin and produced from milk given under varying conditions. Observation has shown that the chemical nature of butter fat is dependent, to a certain extent, on the climatic influences to which the cows are exposed, on the nature and amount of the food supplied, and on the breed, period of lactation, and idiosyncrasy of the individual cow. In order to give such weight as was practicable to the effect of these factors, the samples of butter were obtained from carefully selected districts, and often from cows set apart for the purpose of the inquiry, whilst particulars of the breed, diet, stabling, and period of lactation were supplied with the samples in nearly all cases. For example, to illustrate the effects of more rigorous climatic conditions than obtain in the United Kingdom generally, farms and dairies in Caithness, Sutherland, the Orkneys, Shetlands, and the Hebrides were laid under contribution, whilst a series of samples from Hollesley Bay, Suffolk, served to exemplify the effect on the cattle of exposure to the winds of the North Sea.

Of the 430 samples received, 357 were examined as regards their Reichert-Wollny number, their relative density, saponification value, and refractometric value, and in a certain number of typical cases their Hübl value was ascertained.

The main results of these observations have been tabulated and compared and their interdependence exhibited by means of curves.

10. "A simple thermostat for use in connection with the refractometric examination of oils and fats." By Thomas Edward Thorpe.

The thermostat is primarily intended for use in connection with the Zeiss butyro-refractometer, in which a current of water, usually at about 45° or a little warmer, is caused to circulate round the prism casing. This arrangement is somewhat more convenient than that usually employed, occupies less space, and is sooner brought into action. It has for some years past been employed in the Government Laboratory in the examination of butter.

11. "**The condensation of furfuraldehyde with sodium succinate.**" **By Arthur Walsh Titherley and James Frederick Spencer.**

Fittig has shown (*Annalen*, 1883, **216**, 97; 1889, **255**, 1—142) that aldehydes condense with sodium succinate in the presence of acetic anhydride, giving substituted paraconic and *iso*crotonic acids:

$$R\cdot CH{:}O + \begin{matrix} CH_2\cdot CO_2H \\ | \\ CH_2\cdot CO_2H \end{matrix} \longrightarrow \begin{matrix} R\cdot CH\cdot CH(CO_2H)\cdot CH_2\cdot CO \\ | \qquad\qquad\qquad\qquad | \\ O\text{---------------} \end{matrix} \longrightarrow R\cdot CH{:}CH\cdot CH_2\cdot CO_2H,$$

where R is any alkyl or aryl radicle.

The authors in attempting to employ this method for the synthesis of β-furfurylidenepropionic (furfuryl*iso*crotonic) acid by condensing furfuraldehyde with sodium succinate in presence of acetic anhydride found that neither it nor furfurylparaconic acid is formed, but two unexpected derivatives were produced, which were isolated with considerable difficulty, the yields being very small.

One of these substances, which crystallised in dark orange-coloured needles melting at 187°, was found to be *difurfurylidenesuccinic anhydride*, $C_{14}H_8O_5$, and the other, which separated in bright yellow plates (m. p. 213°), was identified as *αγ-difurfurylidenepropionic acid*, $C_{13}H_{10}O_4$. These results indicated that two furfuraldehyde molecules condensed with one molecule of sodium succinate, and all attempts to prepare the corresponding monofurfurylidene derivatives failed.

These products may be regarded as being produced from the difurfurylidene derivative in the following manner:

$$\begin{matrix} C_4H_3O\cdot CH{:}C\cdot CO_2H \\ C_4H_3O\cdot CH{:}C\cdot CO_2H \end{matrix}$$

$$\begin{matrix} C_4H_3O\cdot CH{:}C\cdot CO \\ C_4H_3O\cdot CH{:}C\cdot CO \end{matrix}\!\!>\!O \qquad\qquad C_4H_3O\cdot CH{:}CH \\ C_4H_3O\cdot CH{:}C\cdot CO_2H$$

m. p. 187°. m. p. 213°.

The orange-coloured anhydride is decomposed with difficulty by sodium hydroxide, forming sodium *difurfurylidenesuccinate*; the acid is a yellow, crystalline powder melting at 185—187° and regenerating the anhydride. The acid is also converted into the anhydride on gently warming with acetyl chloride.

The anhydride readily combines with bromine, yielding the well-defined tetrabromide, *aaββ-tetrabromo-s-difurfuryleuccinic anhydride*, $\begin{matrix} C_4H_3O\cdot CHBr\cdot CBr\cdot CO \\ C_4H_3O\cdot CHBr\cdot CBr\cdot CO \end{matrix}\!\!>\!O$, a bright yellow powder melting at 196° and giving fluorescent solutions.

The yellow $a\gamma$-difurfurylidenepropionic acid (m. p. 213°) was obtained as the sole crystallisable product and in larger yield, on using succinic anhydride as the dehydrating agent instead of acetic anhydride, but in all cases the condensation of furfuraldehyde with sodium succinate was accompanied by the formation of large quantities of resinous matter.

12. "The action of heat on α-hydroxycarboxylic acids. A preliminary note." By Henry Rondel Le Sueur.

The *aldehyde*, $C_{16}H_{33}\cdot CHO$, which is produced by heating α-hydroxystearic acid, crystallises from light petroleum in needles melting at 36°, and from alcohol in needles containing 1 mol. of the solvent and melting at 52°; it forms a crystalline *compound* with sodium hydrogen sulphite, and the *oxime* and *semicarbazone* melt at 89·5° and 107—108° respectively.

The *acid*, $C_{16}H_{33}\cdot CO_2H$, obtained by oxidising the aldehyde with potassium permanganate, crystallises from light petroleum in long needles melting at 60—61°; the *silver* salt, $C_{17}H_{33}O_2Ag$, is amorphous.

The author is investigating the action of heat on other mono- and di-basic α-hydroxy-acids.

13. "The fusion of *iso*pilocarpine with caustic potash. A correction." By Hooper Albert Dickinson Jowett.

In a communication on the constitution of pilocarpine (*Trans.*, 1900, **77**, 860), the author showed that an acid, then regarded as *iso*butyric acid, was produced by the fusion of *iso*pilocarpine with caustic potash. The existence of the *n*-butyl group in *iso*pilocarpine, as proved by the formation of α-ethyltricarballylic acid from homopilopic acid, and the production of *n*-butyric acid by fusion of pilopic acid with caustic potash, however, rendered it probable that the acid previously described as *iso*butyric acid was really *n*-butyric acid. The experiment has therefore been repeated.

Ten grams of *iso*pilocarpine were fused with 100 grams of caustic potash, and the fatty acid separated in the manner previously described (*loc. cit.*). The portion distilling between 120° and 160° was collected and converted into the calcium salt by neutralisation with calcium carbonate. The acid was not soluble in a small amount of water, but dissolved almost completely in a larger quantity. The calcium salt, which separated from the hot aqueous solution on concentration, was collected while hot; it formed white, pearly plates, which were dried in the air and analysed:

0·1982 lost 0·0162 H_2O at 150°. $H_2O = 8·2$.
0·1780 „ 0·0144 H_2O „ 100°. $H_2O = 8·1$.
$(C_4H_7O_2)_2Ca,H_2O$ requires $H_2O = 7·8$ per cent.

Calcium *iso*butyrate crystallises with 4 molecules of water.

On warming an aqueous solution of the salt, saturated at 0°, crystals separated, which redissolved on cooling.

The silver salt was prepared and recrystallised from water.

0·1312 gave 0·0726 Ag. Ag = 55·3.

$C_4H_7O_2Ag$ requires Ag = 55·4 per cent.

The volatile acid formed by the fusion of *iso*pilocarpine with caustic potash is therefore *n*-butyric acid.

14. "**Organic derivatives of silicon. Preparation of alkylsilicon chlorides.**" **By Frederic Stanley Kipping.**

It has been previously shown that tetra-alkyl derivatives of silicon can be obtained by treating silicon tetrachloride with alkyl halides in presence of sodium (Kipping and Lloyd, Trans., 1901, 79, 449). The investigation of silicon compounds has recently been resumed in conjunction with Mr. A. Hunter, and attempts have been made to prepare compounds of the type $SiR_1R_2R_3Cl$ with the following results.

Silicon tetrachloride interacts vigorously with an ethereal solution of magnesium ethyl iodide, the product consisting of a mixture of ethylsilicon trichloride, diethylsilicon dichloride, triethylsilicon chloride, and silicon tetraethyl, the proportions of which depend on the relative quantity of the magnesium compound employed.

Silicon tetrachloride also interacts very vigorously with an ethereal solution of magnesium ethyl bromide; when molecular proportions of the two compounds are used, the product contains a small quantity of the di- and tri-ethyl derivatives, but consists principally of ethyl silicon trichloride, which can be isolated by fractional distillation and has the properties assigned to it by Ladenburg.

Ethylsilicon trichloride and an ethereal solution of magnesium phenyl bromide interact very readily, and *phenylethylsilicon dichloride* can be isolated by fractional distillation; this compound is a fuming liquid boiling at about 228—230° and readily decomposed by water, giving an oil which appears to be the *silicoketone*, SiEtPhO.

Phenylethylsilicon dichloride and an ethereal solution of magnesium propyl bromide do not give an immediate precipitation of magnesium salt, but on warming, a reaction occurs with the formation of *phenylethylpropylsilicon chloride*, which is obtained after fractional distillation, mixed apparently with unchanged dichloride, as a colourless liquid boiling indefinitely at about 240°.

These and other alkyl derivatives of silicon tetrachloride are now being examined, and, in conjunction with Dr. Caven, analogous experi-

ments have been commenced with the object of preparing mixed alkyl derivatives of phosphorus, more especially compounds of the type $POR_1R_2R_3$ or $POR_1R_2{\cdot}OH$.

15. "Derivatives of highly substituted anilines." By Frederick Daniel Chattaway and John Mello Wadmore.

The authors described the preparation and properties of a series of highly substituted acyl- and chloro-amines obtained in the course of an investigation into the phenomena of intramolecular rearrangement in aromatic amines.

ERRATUM.

(PROC., 1903, 19, No. 273.)

Page 282, line 9 from bottom, *for* "trialkylhydroxylamines"
read "trialkyloxamines."

At the next Meeting, on Thursday, February 4th, at 8 p.m., the following Papers will be communicated:

"The tautomeric character of the acidic thiocyanates. A preliminary note." By R. E. Doran.

"The resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents." By R. S. Morrell and E. K. Hanson.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 13/2/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 275.

Thursday, February 4th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. F. G. Smith, H. F. Knight, G. J. Alderton, A. J. Carrier, and F. B. Gatehouse were formally admitted Fellows of the Society.

The PRESIDENT announced that the Council had resolved that a congratulatory address should be sent to Prof. Mendeléeff on the occasion of his 70th birthday on Tuesday next, February 9th, a date which would also be that of his official retirement, although he would actually remain at his post for another year.

Certificates were read for the first time in favour of Messrs.

Robert Bridgett, M.A., B.Sc., 32, Queen Anne Street, Dunfermline.
Tom Sidney Moore, B.A., B.Sc., 99, Rann Street, Birmingham.
Clarence Smith, D.Sc., Denmark Lodge, Hatcham, S.E.
Gerald Oscar Morgan-Smith, The Studio, Trowse, Norwich.
Reginald Harry H. Stanger, 33, Ladbroke Grove, W.
John Weinberg, Rosa, United Provinces, India.

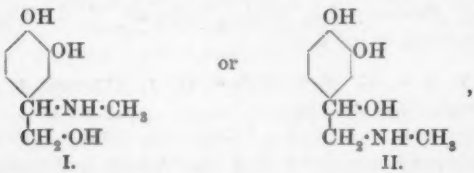
Of the following papers, those marked * were read:

***16. "The constitution of epinephrine." By Hooper Albert Dickinson Jowett.**

"Epinephrin" was the name given by Abel and Crawford to the active principle of the suprarenal glands, and the substance is identical, when pure, with the "adrenalin" of Takamine and the "suprarenin" of von Fürth. As Abel and Crawford were the first to isolate the active principle, although in an impure condition, the author has adopted the name proposed by them. Analysis and molecular weight determinations of carefully purified material confirmed the formula $C_9H_{13}O_3N$, first produced by Aldrich. In dilute acetic acid solution, the compound has $[\alpha]_D - 32{\cdot}6°$.

On oxidation with potassium permanganate, methylamine and oxalic and formic acids were formed. By fusion with potassium hydroxide, a small amount of a crystalline substance was obtained which gave the protocatechuic acid reaction with ferric chloride. On methylation with methyl iodide and sodium in methyl alcohol and subsequent oxidation with potassium permanganate, trimethylamine and veratric acid were obtained.

The bearing of these results on the constitution of the base was discussed, the following alternative formulæ being put forward:



the second of which was considered the more probable.

***17. "Studies on the electrolytic oxidation of phenols. Part I." By Arthur George Perkin and Frederick Mollwo Perkin.**

When pyrogallol was oxidised in neutral or slightly acid solutions, purpurogallin was precipitated in a very pure condition as an orange-red powder, the best results being obtained with an electrolyte of 15 per cent. sodium sulphate. The iridio-platinum anode, which was rotated during the electrolysis, and the leaden cathodes were not separated by means of a porous cell. With a current density of 2 amperes

per square decimetre, the *E.M.F.* was 4·3—4·5 volts (compare *Proc.* 1903, **19**, 58).

When gallic acid was oxidised with an electrolyte of sodium acetate and acetic acid, a black or brown powder was obtained, which was found to be purpurogallincarboxylic acid. In this case, the current conditions were practically the same as in the preceding experiment, but the anode and cathode were separated by means of a porous cell. The purpurogallincarboxylic acid thus obtained is not pure, and the yield is very variable.

***18. "Action of nitrogen peroxide on 1-nitrocamphene." By Martin Onslow Forster and Frances Mary Gore Micklethwait.**

When a current of nitrogen peroxide is passed into a chloroform solution of 1-nitrocamphene (*Trans.*, 1901, **79**, 644), the temperature rises, crystals separate, and the filtrate becomes bluish-green. The *nitrosate*, $C_{10}H_{15}O_6N_3$, thus produced to the extent of 24 per cent., is very sparingly soluble in organic media and melts at 217°, when it decomposes; it is probably bimolecular.

The *compound*, $C_{10}H_{14}O_4N_2$, obtained by the limited action of alcoholic ammonia, piperidine, or potassium hydroxide on the foregoing substance, is insoluble in dilute acids and alkalis; it crystallises from alcohol in transparent prisms melting at 123°, and has $[\alpha]_D$ −159·0°.

By the continued action of alcoholic alkali, a green oil is produced which may also be extracted from the bluish-green chloroform mother liquor of the nitrosate; the substance forms a brown solution in alkali hydroxides, and has not been analysed because it decomposes spontaneously when isolated.

The *compound*, $C_{10}H_{14}O_5N_2$, formed on oxidising with potassium ferricyanide the green oil dissolved in potassium hydroxide, crystallises from light petroleum in snow-white needles melting at 85—86°. It dissolves in sodium carbonate and develops a red coloration with ferric chloride; the *silver*, *copper*, and *ammonium* derivatives have been analysed. The *bromo*-derivative, $C_{10}H_{13}O_5N_2Br$, precipitated when potassium hypobromite acts on solutions in alkali hydroxides, crystallises from alcohol in colourless needles melting at 157°, and has $[\alpha]_D$ −68°. Alcoholic potash regenerates the substance $C_{10}H_{14}O_5N_2$.

The *compound*, $C_{10}H_{11}O_5N_2Br_3$, produced by the action of potassium hypobromite on the green oil dissolved in potassium hydroxide, crystallises from light petroleum in pale brown prisms melting at 78°; it has $[\alpha]_D$ +4·2°.

Methylaminocamphene, $C_{10}H_{15}{\cdot}NHMe$, was prepared by treating with methyl iodide the benzylidene derivative of the primary base, and

hydrolysing the product with moist ethyl acetate ; it boils at 202— under 756 mm. pressure, has sp. gr. 0·9171 at 22°, and $[\alpha]_D$ +28·7° in absolute alcohol. The *platinichloride* melts and decomposes at 214°.

19. "The tautomeric character of the acyl thiocyanates. A preliminary note." By Robert Elliott Doran.

In the course of the present investigation (compare Dixon, *Trans.*, 1901, **79**, 543), it has been established that the tendency for acetyl thiocyanate either to react as such or to behave as a thiocarbimide depends almost entirely on the temperature, although the tautomeric change is also influenced to some extent by the nature of the base with which the compound is caused to interact.

Thus, when aniline is employed, it is possible to bring about the changes indicated by either of the following equations:

I. $CH_3CO{\cdot}SCN + 2PhNH_2 = PhNH{\cdot}CO{\cdot}CH_3 + PhNH_2{,}HSCN$;

II. $CH_3{\cdot}CO{\cdot}NCS + PhNH_2 = CS(NHPh){\cdot}NH{\cdot}CO{\cdot}CH_3$;

the first reaction takes place at the ordinary temperature, and the second on warming.

By means of the latter reaction, several new acetylated thioureas have been prepared, together with others (for example, acetylthiourea), which, although previously described, have not hitherto been obtained directly from the parent substance. The yields obtained with various bases and at different temperatures have also been studied.

20. "Resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents." By Robert Selby Morrell and Edward Kenneth Hanson.

Of a series of salts of the active bases with $\alpha\beta$-dihydroxybutyric acid, derived from α-crotonic acid, the quinidine salt is the only one which admits of resolution into its two active components, so that these can be separated by crystallisation from water. The quinidine *l*-salt is very sparingly soluble in this solvent, and from it the *l*-$\alpha\beta$-dihydroxybutyric acid has been prepared. The free acid has the same melting point as the racemic substance, but it crystallises in six-sided plates and not in needles. Its specific rotation is −13·5°, this being numerically greater than that of *d*-glyceric acid, which has $[\alpha]_D$ +2·14° (Frankland and Frew, *Trans.*, 1891, **59**, 96), and smaller than that of *l*-β-hydroxybutyric acid ($[\alpha]_D$ −24·8°) (Mackenzie, *Trans.*, 1903, **81**, 1402). The barium salts of the *d*- and *l*-acids have been prepared, and the specific rotation of the barium

l-salt is greater than that of the free acid. Faber and Tollens (*Ber.*, 1899, **32**, 2598) have described salts of a dihydroxybutyric acid, obtained, together with *iso*saccharic acid, by the action of lime water on oxycellulose. The rotation of this $\alpha\beta$-dihydroxybutyric acid is given as $+13{\cdot}7°$, and it is probable that this acid is the *d*-isomeride, corresponding with the *l*-modification obtained from α-crotonic acid.

21. "Aromatic compounds obtained from the hydroaromatic series. Part I. The action of bromine on 3 : 5 dichloro-1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene." By Arthur William Crossley.

Dichlorodimethyldihydrobenzene, on treatment with two molecular proportions of bromine, yields *dichlorotribromodimethyltetrahydrobenzene*, $C_8H_9Cl_2Br_3$, crystallising in stout, prismatic needles and melting at 118°. When heated to a few degrees above its melting point, this substance rapidly evolves two molecular proportions of hydrogen bromide, giving rise to 3 : 5-*dichloro*-4-*bromo*-o-*xylene*, which crystallises in felted needles melting at 100°. The constitution of this aromatic compound has been definitely decided by synthesis.

If, however, dichlorodimethyldihydrobenzene is treated with only one molecular proportion of bromine, an unstable liquid results, which, on heating, loses hydrogen bromide, giving as the main products 3 : 5-dichloro-*o*-xylene and 3 : 5-*dichloro*-6-*bromo*-o-*xylene* (m. p. 42°).

On further bromination, both these dichlorobromoxylenes give 3 : 5-*dichloro*-4 : 6-*dibromo*-o-*xylene*, crystallising from ethyl acetate in glistening needles (m. p. 233°), but they differ markedly in their behaviour towards nitric acid.

Thus, 3 : 5-dichloro-4-bromo-*o*-xylene, on treatment with fuming nitric acid, gives 3 : 5-*dichloro*-4-*bromo*-6-*nitro*-o-*xylene*, and yields 3 : 5-*dichloro*-4-*bromo*-o-*phthalic acid* when oxidised with dilute nitric acid under pressure, whereas under similar conditions, 3 : 5-dichloro-6-bromo-*o*-xylene furnishes respectively 3 : 5-*dichloro*-4 : 6-*dinitro*-o-*xylene* and 3 : 5-*dichloro*-6-*nitro*-o-*toluic acid*.

22. "The action of nitrogen sulphide on organic substances. Part I." By Francis Ernest Francis and Oliver Charles Minty Davis.

Nitrogen sulphide reacts readily with aromatic aldehydes. Benzaldehyde gives triphenylcyanidin (cyaphenin) and a small quantity of lophin, probably formed by the reduction of the former compound by the sulphur dioxide liberated in the reaction. *p*-Tolualdehyde reacts similarly, giving the corresponding tritolylcyanidin. Anisaldehyde,

however, yields only very small quantities of *p*-trimethoxyphenylcyanidin, the main product of the reaction being a white, insoluble powder, which is at present under investigation.

23. "Dibenzoylchloroimide." By Frederick Daniel Chattaway.

The author points out that Stieglitz and Earle have overlooked his paper (*Proc.*, 1902, **18**, 165; *Chem. Centr.*, 1902, II, 359), communicated to the Society on June 18th, 1902, which contains a description of the preparation and properties of the diacylchloroimides, including the dibenzoylchloroimide again described by these investigators (*Amer. Chem. J.*, 1903, **30**, 420). Stieglitz and Earle state that, owing to the ease with which the diacylchloroimides are hydrolysed, it is necessary to exclude water entirely in the preparation of these substances. This, however, is contrary to the author's experience, for the chloroimides are readily obtained in the presence of water in the manner indicated in the former paper (*Proc.*, *ibid.*).

Dibenzoylchloroimide, when pure, melts at 89°, or three degrees higher than the temperature given by Stieglitz and Earle.

The diacylchloroimides are readily hydrolysed, yielding the diacylimides and hypochlorous acid either when left in contact with water or when heated with this medium, but the reaction is reversible.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Clowes, Frank, and Coleman, J. Bernard. Elementary practical chemistry. Part II. Analytical chemistry. 4th ed. pp. xvi + 212. ill. London 1903. From the Authors.

Dibdin, W. J. The purification of sewage and water. 3rd ed. pp. xxxv + 379. ill. London 1903. From the Author.

Dyer, Bernard. Fertilisers and feeding stuffs. Their properties and uses. With the full text of the Fertilisers and Feeding Stuffs Act, 1893, the regulations and forms of the Board of Agriculture, and notes on the Act by A. J. David. 4th ed. pp. 124. London 1903. From the Author.

Muter, John. A short manual of analytical chemistry, qualitative

and quantitative—inorganic and organic. Following the course of instruction given in the laboratories of the South London School of Pharmacy. 9th ed. pp. xiv + 235. ill. London 1903.
From the Author.

New South Wales. Department of Mines and Agriculture. Memoirs of the Geological Survey. Geology, No. 3. The kerosene shale deposits of N.S.W.; with maps, plates, and sections. By J. E. Carne. Sydney 1903. From the Department.

Royal Commission on Arsenical Poisoning. Reports of the Royal Commission appointed to enquire into arsenical poisoning from the consumption of beer and other articles of food and drink. 4 vols. London 1901—1903. From the Commission.

II. *By Purchase.*

Ahrens, Felix B. Handbuch der Elektrochemie. 2 Auflage. pp. x + 686. ill. Stuttgart 1903.

Benedikt, Rudolf. Analyse der Fette und Wachsarten. Vierte, erweiterte Auflage, bearbeitet von Ferdinand Ulzer. pp. xii + 941. ill. Berlin 1903.

Delbrück, M., und Schönfeld, F. System der natürlichen Hefereinzucht. Gesammelte Vorträge und Arbeiten. pp. viii + 148. Berlin 1903.

Lunge, George. A theoretical and practical treatise on the manufacture of sulphuric acid and alkali, with the collateral branches. Vol. I. Sulphuric Acid. pp. xxvii + 1214. ill. 2 vols. London 1903.

At the next Meeting, on **Wednesday**, February 17th, at 5.30 p.m. there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Observations on some continuous intramolecular and at first reversible changes extended over prolonged periods of time." By R. J. Friswell.

"The esterification of *r*-mandelic acid by menthol and borneol." By A. McKenzie.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 17th, 1904.

Ackroyd, John Prest,

116, Richmond Street, Accrington, Lancashire.

Master of Chemical Department, Municipal Technical School, Accrington. Student in Chemical Department, Yorkshire College, Leeds, 1897—1900. B.Sc. (London). Chemistry taken in Final Examination, 1900. Teacher of Chemistry, 1902 and 1903, in Technical Schools, viz., Waverley Road Higher Grade, Birmingham, and Technical School, Accrington. Desirous of keeping in touch with recent work through the Chemical Society.

Arthur Smithells. H. M. Dawson.
J. B. Cohen. Fredk. Doyle.
W. T. Leeming.

Baguley, Allan,

University College of North Wales, Bangor.

Assistant Lecturer in Agricultural Chemistry. Bachelor of Science (with Second Class Honours in Chemistry), University of Wales. Associate of the Institute of Chemistry.

Kennedy J. P. Orton. Harry Baker.
Alexander Lauder. James J. Dobbie.
James Robson.

Bennett, Charles Thomas,

57, Larkhall Rise, Clapham, S.W.

Analytical chemist in laboratory of Messrs. Wright, Layman, and Umney, Ltd., Southwark, S.E., during the last five years. Pharmaceutical Chemist. Honours in Chemistry at Intermediate B.Sc. (Lond.), 1901. Working for B.Sc. (Honours in Chemistry) at South-Western Polytechnic under Prof. Coleman. Papers on Copaiba, Olive Oil, and Chinese Neroli Oil, in conjunction with J. C. Umney, Esq., and on Adulterated Citronella and Peppermint Oils in conjunction with E. J. Parry, Esq., B.Sc.

Chas. Umney. — Thos. Tyrer.
John C. Umney. — J. B. Coleman.
Ernest J. Parry. — Peter MacEwan.

Benson, Alick Cole,

33, Perham Road, W. Kensington.

Analytical Chemist. Studied two years at St. George's Hospital, passed exams. in Chemistry and Biology for M.R.C.S., L.R.C.P. Two years as pupil, afterwards as assistant, in the laboratory of Mr. Matthew J. Cannon. At present engaged as Chemist to the Granular Yeast Co., Clapton.

Matthew J. Cannon. — Matthew Cannon.
Leonard Temple Thorne. — Edgar Foll.

Alfred C. Chapman.

Broderick, George Edward Peach,

"Bryn Llewelyn," Lampeter, S. Wales.

Science Master at St. David's College School, Lampeter. Bachelor of Science, London University. Five and a half years in the laboratory of Messrs. Blackwell, Hayes and Co., Manufacturing Chemists, Moor Street, Birmingham. Now engaged in teaching, and wishing to have the advantages of the Society to be able to keep in touch with present work in Chemistry.

T. Goode Joyce. — Robert H. Pickard.
T. Slater Price. — Keith B. Benham.

Percy F. Frankland.

Cowper, Alfred Denys,

3, Bishop's Mansions, Fulham, S.W.

Student. One year in Chemical Laboratory, University College,

London, as student. Intermediate Science Exam. London Univ., September, 1902, First Class Pass.

William Ramsay.	C. E. Kenneth Mees.
J. Norman Collie.	Morris W. Travers.
N. T. M. Wilsmore.	John R. Tustin.

Drugman, Julien,

La Bocca, Cannes, France.

Research Student at Owens College, Manchester. I obtained the Ph.D. degree (Bonn) with a dissertation on "Acid-esters of some Dibasic Acids." Worked later under Professor Ramsay ("On the Specific Gravity of the Halogens at their Boiling Points"). Then was Assistant Lecturer at Reading College for two years. Am now doing research work at Owens College.

Harold B. Dixon.	W. H. Perkin, jun.
William Ramsay.	William A. Bone.

D. L. Chapman.

Evans, Nevil Norton,

Montreal, Canada.

Assistant Professor of Chemistry, McGill University. Since graduation from McGill University in 1886, has, with the exception of two years spent in Germany with Winkler at Freiberg and Ostwald in Leipzig, been engaged in teaching at McGill, as demonstrator, lecturer, and Assistant Professor.

B. J. Harrington.	A. Stansfield.
J. Wallace Walker.	Jeffrey H. Burland.

G. P. Girdwood.

Forrest, James Rocheid,

Kirkee, near Poona, India.

Major, Royal Army Medical Corps. "The proteids of red marrow," in *Journal of Physiology*, 1894 (?). "The antiseptic action of certain inorganic salts" (with Prof. Hewlett of King's Coll., not yet published); D.P.H. Camb.; late Sanitary Officer, Oudh District, and Off'g Sanitary Officer, Bengal Command.

John E. Mackenzie.	Lewis Eynon.
H. F. C. Goltz.	*Holland Crompton.*

F. Southerden.

Fry, George,

Carlin Brae, Berwick-on-Tweed.

A timber merchant, who has devoted his leisure hours to the study of chemistry since 1867. Up to 1889 was constantly engaged in the

production of cellulose from wood, and the chemical questions connected therewith. He has undertaken the investigation of several biological, physiological, and chemical problems, the results of one of which he published in 1885 under the title of the "Theory of sweet ensilage." He is still engaged in research connected with the growth of trees and plants; desires to keep himself informed of the advance in organic chemistry bearing on the subjects in which he is interested. Fellow of the Linnean Society.

J. Augustus Voelcker. C. F. Cross.
Edward Bevan. *Bernard Dyer.*

E. W. Voelcker.

Gawler, Robert,

3, South View Terrace, Bennett Road, Headingley, Leeds.

Assistant Science Master at the Technical School, Dewsbury. For four years a student at the Yorkshire College. Graduated B.Sc. (1900), Honours School of Chemistry (1901), M.Sc. (1903).

Arthur Smithells. Julius B. Cohen.
H. M. Dawson. Henry R. Procter.

H. J. Taylor.

Glover, Harry James,

33, Albert Road, Stroud Green, N.

Assistant Science-Master in the Stationers' Company's School, Hornsey, N. Internal Student of the University of London. "Honours" courses in Chemistry under Dr. Dunn and Dr. Mackenzie during past four years. Assistant-Master, Stationers' School, 1900—1903.

W. J. Stainer. Alex. W. Bain.
W. H. C. Jemmett. Alfred Greeves.

Albert E. Dunstan.

Goodson, John Augustus,

19, Darnley Road, Hackney, N.E.

Assistant Chemist to the Aylesbury Dairy Co. Certificated day-student of Finsbury Technical College. Matriculated Student of London University.

H. Droop Richmond. John Castell-Evans.
R. Meldola. Chas. R. Darling.
F. Southerden.

Guthrie, John Monteath,

199, Ferry Road, Leith, N.B.

Analytical Chemist. Studied Chemistry in Edinburgh School of

Medicine and in Heriot-Watt College, Edinburgh. Assistant to the City Analyst, Edinburgh, for over four years, being head assistant for over a year. Assistant Chemist to the Distillers' Co., Ltd., for two years, and Assistant Chemist to Wm. Younger and Co., Brewers, Edinburgh, for three years.

J. Falconer King. Hugh Marshall.
John E. Mackenzie. John S. Ford.

George Young.

Guttmann, Leo Frank,

18, Aberdare Gardens, London, N.W.

Research Chemist. Ph.D. Heidelberg. A.I.C., A.C.G.I. Author of "Percentage Tables for Elementary Analysis" (about to be published in three languages).

Oscar Guttmann. Gerald T. Moody.
William Ramsay. J. Lewkowitsch.
Henry E. Armstrong. Otto Hehner.

Hoit, Alfred Henry,

4, Montgomerie Road, Southsea.

Chemist. Pharmaceutical Chemist. A student of Mr. W. Watson-Will, F.C.S. Chemist and Manager to Messrs. Timothy White Company, Manufacturing Chemists and Wholesale Druggists, Portsmouth.

W. Watson-Will. Thos. H. Moore.
Thos. Tyrer. *Peter MacEwan.*

Frederick B. Power.

McCourt, Cyril Douglas,

52, Victoria Rd., Clapham, S.W.

Research Chemist to The Morgan Crucible Co., Ltd., Battersea, London. Obtained the diploma of Associate of the City and Guilds of London Institute at the termination of a three years' course of Chemistry at the Central Technical College, South Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. T. M. Lowry.

William Robertson.

Mears, Francis D'Oyley, jun,

4, Nyanza Terrace, Swansea.

Brewer's Chemist. Student at Swansea Technical College for three years. Previously privately and since in Brewery Laboratory. I

desire to become a Fellow of the Chemical Society to further my knowledge by attending lectures and obtaining Journal.

Clarence A. Seyler. Stanley J. Peachey.
William J. Pope. W. A. Wayland.

Arthur R. Ling.

Middleditch, Bernard,
Woodcroft, Harrow-on-the-Hill.

Chemistry Master, Harrow School. B.A. of Jesus College, Cambridge.

John Talbot. M. M. Pattison Muir.
B. P. Lascelles. R. S. Morrell.

S. Ruhemann.

Murray, Benjamin L.,
19, University Place, New York City.

Chemist. Have taken following degrees at Univ. of Michigan at Ann Arbor, Ph.C., 1891; B.S. (Chem.), 1896; B.S. (Pharm.), 1897. Engaged as Chemist at State and National Agl. Exper. Station at Geneva, N.Y., 1891—1894. Seven years as chemist for Merck and o., American branch of E. Merck, of Darmstadt, Germany.

Albert B. Prescott. Marston Taylor Bogert.
Otis C. Johnson. C. F. Chandler.

Clifford Richardson.

Patterson, Thomas Stewart,
Lyddon Hall, Leeds.

Assistant Lecturer and Demonstrator in Chemistry at the Yorkshire College, Leeds. Lecturer in Chemistry in the Victoria University. Ph.D. (Heidelberg). Late Priestley Scholar at Mason College, Birmingham. Author or joint author of the following papers:—"Iodoso- and Iodoxy-benzaldehydes" (*Trans.*, 1898); "Mono-, Di-, and Trichloracetyl Methylic and Ethylic Glycerates and Tartrates" (*Trans.*, 1898); "Acetyl and Phenacetyl Derivatives of Diethyl Tartrate" (*Trans.*, 1900); "Preparation of Esters from other Esters of the same Acid" (*Trans.*, 1901); "Influence of Solvents on the Rotation of Optically Active Compounds, Part I" (*Trans.*, 1901); Part II (*Trans.*, 1901); Part III (*Trans.*, 1902); Part IV (*Trans.*, 1902); "Modified Forms of Thermo-Regulator and Adapter for Vacuum Distillation," *J.S.C.I.*, 1902.

Arthur Smithells. J. B. Cohen.
Percy F. Frankland. A. G. Green.
G. G. Henderson. A. G. Perkin.
T. L. Patterson. H. M. Dawson.

C. F. Baker.

Prentice, Bertram,

Royal Technical Institute, Salford.

Head of the Chemistry Department, Roy. Technical Inst., Salford. Graduated Ph.D. (Munich) in 1895, and D.Sc. (Edinburgh) in 1902. Published papers on "Some Derivatives of Dimethylacrylic Acid" (*Annalen*, 292, 272), and on "Pulegone," in *Ber. der deutsch. Chem. Ges.*, 29, 1078.

W. H. Perkin, jun. — Francis Jones.
G. H. Bailey. — George Young.
Jas. R. Appleyard.

Sen, Jatindranâth,

71, Cathedral Mission Lane, Calcutta, India.

Student of Chemistry. M.A. Calcutta (1899). Premchand Roychand Studentship (Research). Two papers:—"Uber die Zersetzung der Merkurammoniumsalze unter dem Einfluss der Wärme," *Zeit. anorg. Chem.*, Bd. 33, (1902), S. 198. "Decomposition of Mercurous Nitrite by Heat," by Dr. P. C. Rây and Jatindranâth Sen, *Journ. Chem. Soc., Trans.*, Vol. 83, (1903), P. 491.

William Tate. — H. E. Stapleton.
P. C. Rây. — Alex. Pedler.
Chuni lal Bose.

Shrubsole, Alfred,

91, Holyhead Road, Coventry.

Analytical Chemist. Major Qualification of Pharmaceutical Society of Great Britain. Student in Chemistry for 18 months at the Liverpool School of Pharmacy under the late J. S. Ward, Esq., F.C.S. Studied for 4 months at the Central School of Chemistry, London, under the late J. Woodland, Esq., F.C.S., F.L.S. Have worked specially in Coal and Fuel Analysis, Drugs and Commercial Chemicals; and for the last 18 months as Assistant Analyst, under H. W. Jones, Esq., F.C.S., in the laboratories of Messrs. Wyley's, Ltd., Coventry. Am anxious to receive current literature of the Society.

W. F. Wyley. — W. F. J. Shepheard.
H. W. Jones. — John Bairstow.
W. F. Lowe.

Siau, Raymond Louis,

15, Merridale Lane, Wolverhampton.

Chemist to a Brewing Company. Lond. matric. 1886. Student

R. C. Science, 1888—9. Assistant to F. W. Pavy, F.R.S., 1890—1903. Contributions with F. W. Pavy to the *Journal of Physiology*.

W. D. Halliburton. Julian L. Baker.
Adrian J. Brown. M. O. Forster.
Arthur R. Ling. G. T. Morgan.

Smith, Samuel John,
41, Grafton Street, Dublin.

Pharmaceutical Chemist and Lecturer on Chemistry (private). I desire admission to the Society in order to follow the modern developments of chemistry.

Chas. R. C. Tichborne. James S. Ashe.
Jos. F. Burnett. Harold W. Harrie.
Thos. Tyrer.

Stevenson, Henry Ernest,
"Avondale," Ditton Hill, Surrey.

Manufacturing Chemist. Five years' private training prior to 1879. From 1880 to 1894 a partner in the firm of Fletcher, Fletcher and Stevenson, Manufacturing Chemists, Holloway, N. Subsequently principal of H. E. Stevenson and Co., now incorporated into that of Baiss Brothers and Stevenson, Limited (established prior to 1833), Manufacturing Chemists, Jewry Street, E.C., of which Company I am Managing Director.

David Howard. Chas. Umney.
D. Lloyd Howard. John C. Umney.
Wm. Chattaway.

Streatfeild, Frederick Henry,
9, Crescent Road, South Tottenham, N.

Senior Demonstrator and Assistant Lecturer at the West Ham Municipal Technical Institute. Certificated City and Guilds Technical College, Finsbury. Two years Research Assistant to Prof. R. Meldola, F.R.S. Co-author, with Prof. Meldola, of a paper on "Phenol Derivatives," published in the Journal of the Chemical Society. Six years Senior Demonstrator and Assistant Lecturer in Chemistry at the West Ham Municipal Technical Institute. Recognised Teacher of the London University.

Harold A. Auden. Gerald T. Moody.
R. Meldola. H. Harding.
F. Southerden. *William A. Davis.*

Thompson, Charles Herbert,

Hillcroft, Amblecote, Stourbridge.

Chemist. After going through courses of Organic and Inorganic Chemistry and the usual Analytical Work, I have during the last ten years been engaged in Ceramic Chemistry and the study of the production of coloured glass with a view to produce compounds of any desired colour and coefficient of expansion, and I am at present engaged in this work. I have worked at this special branch of Chemistry in England and under Monsieur Oton. Isbecque, of Charleroi, and Floreffe in Belgium. Also under other continental Chemists, and particularly under the systems of M. Leon Appert and M. Jules Henrivaux, of Paris, France.

William Thomson.	*J. Carter Bell.*
William J. Pope.	*C. Estcourt.*
Edgar Neuman.	*T. Fairley.*

Thompson, Hubert,

Agricultural College, Holmes Chapel, Cheshire.

Lecturer in Chemistry and Analyst at the above. Lecturer in Chemistry during the past 12 months at the Cheshire Agricultural College ; 4 years as student at the Yorkshire College, obtaining the Degree of B.Sc. in 1902, Chemistry being one of the subjects of examination.

Arthur Smithells.	H. M. Dawson.
Julius B. Cohen.	C. E. Womersley.
W. Lowson.	A. Peacock.

Tingle, Alfred,

Imperial Provincial College of Shantung, Chinaufu, Shantung, China.

Professor of Chemistry. B.Sc. (Aberdeen and London), Ph.D. (Pennsylvania). Publications :—*Amer. Chem. Jour.*, 25, 144 ; 24, 276 ; 24, 45 ; 23, 214 ; 21, 238 (two latter in conjunction with J. B. Tingle) ; *J. Amer. Chem. Soc.*, 1899, 792 ; *Jour. Soc. Chem. Ind.* (in conjunction with W. Morrison), 22, 730 ; *Trans. Chem. Soc. Lond.* (in conjunction with F. R. Japp, F.R.S.), 1897, 1138.

J. Bishop Tingle.	G. D. Lander.
F. R. Japp.	*W. Carleton Williams.*

George Young.

Underhill, William Wood,

10, Hartham Road, Holloway, N.

Science Master, Higher Grade School, Seven Sisters Road, N., teaching Chemistry and Physics. Associate of the College of Pre-

ceptors. Queen's Prize for Practical Chemistry, 1896. Seven years engaged in teaching Chemistry. For 3 years a student under Dr. J. T. Hewitt. For the last 3 years in sole charge of a Chemical Laboratory. The use of the Society's Library and the Journal would be an invaluable assistance to me professionally.

Edgar E. Horwill. J. T. Hewitt.
A. J. Hyder. *James H. Gardiner.*
Chas. T. F. Watts.

Walling, Léon Edward,
43, Union Rd., Rotherhithe.

Certificated Teacher. Besides four years at Day and Evening Classes in Elementary Work, I have worked for two years as a student under W. T. Boone, Esq., at Cheltenham Training College, and a further two years under Dr. Lapworth at Goldsmiths' Institute, New Cross.

A. Lapworth. A. W. Harvey.
A. C. O. Hann. Will. T. Boone.
A. H. Coote.

Watt, Francis Langston,
111, Lauderdale Mns., Lauderdale Rd., Maida Vale, W.

Analytical Chemist. I am an Associate of the Royal College of Science (in Chemistry), and studied Chemistry also at Technical College, Sydney, New South Wales. I am now studying the analysis of Foods and Drugs in the laboratory of Mr. A. C. Chapman, F.I.C.

Alfred C. Chapman. James C. Philip.
Chapman Jones. F. Guy Stirling Baker.
Fredk. T. Harry.

Whiteley, Charles Edward,
9, Abyssinia Grove, Leeds.

Demonstrator of Chemistry. Student of the Yorkshire College, 1896—1902. Demonstrator in same Institution, 1902— . Published with Dr. Cohen under his guidance, "Experiments on the production of optically active compounds from inactive substances" in *J. C. S. Trans.*, 1901, Vol. 79. At present engaged in research work with Prof. Smithells.

Arthur Smithells. A. G. Perkin.
J. B. Cohen. H. M. Dawson.
W. Lowson. *A. B. Steven.*

Woodcock, William Henry,

10, Chesson Road, W. Kensington, W.

Analytical Chemist. For the last nine years have been assistant to Bertram Blount, Esq.

Bertram Blount. Patrick H. Kirkaldy.
Herbert Jackson. D. Northall Laurie.
R. Curling Styles.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I. (3):

Ghose, Anu,

42, Shambazar Street, Calcutta, India.

Analytical Chemist and Assayer to Messieurs Jambon & Cie., Manganese Mines, C.P., and Copper Mines, Bengal. Demonstrator of Chemistry for three years in St. Xavier's College, Calcutta. Sometime Assistant Chemist, Economic Laboratory, Indian Museum. Author of an investigation on *Asphodelus tenuifolius*, published as an "Agricultural Ledger" by the Government of India.

David Hooper. *Alexander Pedler.*

Montgomery, Jack Percival,

Agricultural College, Starkville, Miss., U.S.A.

Assistant Prof. of Chemistry, A.V.M. College of Miss.; also Assistant State Chemist of Mississipi. Author of "Some New Compounds of Urea with Acids and Salts." The above served for Dissertation for the Doctorate of Philosophy of the University of Va., the investigation being original. Graduate student at University of Va., for two years. Formerly Teacher of Natural Science, Birmingham High School, at Birmingham, Ala., and Assistant Chemist of Republic Iron and Steel Co., at same place. Present position, as above, since September, 1902.

J. W. Mallet. *J. P. Venable.*
F. P. Dunnington. *Chas. Baskerville.*

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 27/2/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 276.

Wednesday, February 17th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Mr. E. R. Buggé was formally admitted a Fellow of the Society.

ertificates were read for the first time in favour of Messrs.

William Barbour, M.A., B.Sc., Grove Villa, Waltham Cross.
R. H. Durward Benn, Westmount, Montreal, Canada.
Ellis Clayton, 6, Spring Hurst Road, Saltaire.
Percy Kent Le May, 6, Lothair Villas, Hatfield, Herts.
Franklin E. Robertson, Harders Road, Peckham, S.E.
Thomas G. Shacklady, Addiscombe Villas, Cliffe-at-Hoo, Kent.

It was announced that the following changes in the Officers and Council were proposed by the Council:

As Treasurer: Dr. A. Scott, F.R.S., *vice* Dr. H. T. Brown, F.R.S.

As Secretary: Dr. M. O. Forster, *vice* Dr. A. Scott, F.R.S.

As Vice-Presidents: Dr. H. T. Brown, F.R.S., and Prof. H. B. Dixon, F.R.S., *vice* Prof. H. McLeod, F.R.S., and Prof. H. A. Miers, F.R.S.

As Ordinary Members of Council: Dr. Bernard Dyer, Mr. A. D.

Hall, Dr. A. Lapworth, Prof. J. M. Thomson, F.R.S., *vice* Dr. M. O. Forster, Mr. S. U. Pickering, F.R.S., Dr. J. A. Voelcker, and Prof. J. Walker, F.R.S.

Dr. L. T. Thorne, Dr. G. T. Moody, and Dr. J. Wade were elected to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

John Prest Ackroyd, B.Sc.
Allan Baguley, B.Sc.
Charles Thomas Bennett.
Alick Cole Benson.
George Edward P. Broderick, B.Sc.
Alfred Denys Cowper.
Julien Drugman, Ph.D.
Nevil Norton Evans.
James Rocheid Forrest.
George Fry.
Robert Gawler, M.Sc.
Anu Ghose.
Harry James Glover.
John Augustus Goodson.
John Monteath Guthrie.
Leo Frank Guttmann, Ph.D.
Alfred Henry Hoit.
Cyril Douglas McCourt.
Francis D'Oyley Mears, Jun.
Bernard Middleditch, B.A.
Jack Percival Montgomery.
Benjamin L. Murray, B.S.
Thomas S. Patterson, Ph.D.
Bertram Prentice, Ph.D., D.Sc.
Jatindranâth Sen, M.A.
Alfred Shrubsole.
Raymond Louis Siau.
Samuel John Smith.
Henry Ernest Stevenson.
Frederick Henry Streatfeild.
Charles Herbert Thompson.
Hubert Thompson, B.Sc.,
Alfred Tingle, B.Sc., Ph.D.
William Wood Underhill.
Léon Edward Walling.
Francis Langston Watt.
Charles Edward Whiteley.
William Henry Woodcock.

Of the following papers, those marked * were read:

***24. "Observations on some intramolecular and originally reversible changes extending over prolonged periods of time." By Richard John Friswell.**

The question of the limitation of chemical action to a certain range of temperature was discussed in the light of W. R. Grove's experiments on the dissociation of water by heat, described in the Bakerian Lecture (*Phil. Trans.*, 1847, 137, 1), and of recent experiments at very low temperatures, and it was pointed out that, as a rule, reactions are hastened by elevation of temperature, and hence their course has been less studied than their products.

Reference was made to V. Meyer's labile hydrogen atom, and some results obtained by the author and A. G. Green (*Trans.*, 1885, 47, 917; 1886, 49, 746) were discussed. It is suggested (1) that the labile condition is not confined to hydrogen, (2) that the constitution of a

compound is only relative and exists only so long as the substance is submitted to a certain definite stress, (3) that different stresses develop dissimilar constitutions, and that therefore the constitution of a compound depends on its environment.

Experiments on the changes occurring during very long periods of time were described, these consisting in the slow appropriation by aminoazobenzene base from a solution of aniline hydrochloride of sufficient hydrochloric acid to saturate itself; this reaction was shown to occur even in the presence of much free aniline, and the variations due to changes of temperature were described.

These and analogous experiments are held to justify the arguments as to the effects of stress on the successive disruption of the molecules of aniline hydrochloride and aminoazobenzene hydrochloride.

Preparations illustrating the above-described experiments were exhibited.

Discussion.

Dr. Morgan suggested that the interaction occurring between aniline hydrochloride and aminoazobenzene might be explained in terms of the ordinary theories of chemical equilibrium.

Aniline hydrochloride, in aqueous solution, undergoes dissociation, and attains a state of equilibrium which may be represented approximately by the equation $C_6H_5 \cdot NH_3Cl \rightleftharpoons C_6H_5 \cdot NH_2 + HCl$. This equilibrium is disturbed by the introduction of aminoazobenzene, because this base forms a sparingly soluble hydrochloride and thus gradually abstracts the free acid from the solution. Excess of aniline hinders this change owing to the fact that, being itself a product of the dissociation of the soluble hydrochloride, it reverses the foregoing balanced reaction, in accordance with the law of mass action, thereby decreasing the amount of available hydrochloric acid.

Dr. Hewitt asked whether the proof of the existence of a diazonium salt in an acid solution of diazoaminobenzene during the period of isomerisation to aminoazobenzene did not depend on the coupling properties of such a solution; if so, the demonstration is not conclusive, since it has been known for years that diazoamino-compounds couple with phenols even in the absence of acids. One of the earliest known cases of this reaction was discovered by Heumann and Œconomides, who obtained benzeneazophenol from diazoaminobenzene and phenol (*Ber.*, 1887, **20**, 372).

In reply to Dr. Hewitt, Mr. Friswell said that a full account of the evidence for the presence of diazobenzene chloride in the solution during the conversion of the diazoaminobenzene into aminoazobenzene would be found in the papers published in conjunction with Prof. A. G. Green (*loc. cit.*). Shortly, it consisted in treating the separated

solution with phenols and amines, whereby known azo-dyes were produced and identified.

In reply to Dr. Morgan, he had no objection to make to the explanation based on the suggested tendency to dissociation of aniline hydrochloride in aqueous solution. He had endeavoured to overcome this tendency by the addition of free aniline, but this only delayed the abstraction of the acid by the aminoazo-base, and, in his opinion, furnished additional evidence in favour of the stress hypothesis which he had advocated.

***25. "Note on a magnesium oxybromide." By George William Fraser Holroyd.**

An ethereal solution of magnesium phenyl bromide, obtained by Grignard's method (*Ann. Chim. Phys.*, 1901, **24**, 437), when saturated with acetylene and left in a stoppered vessel for several days, deposited clear, colourless crystals having the form either of octohedra or of combinations of the octohedron and cube. The yield of crystals was about 4 grams from 50 grams of bromobenzene.

The volume of the solution before passing the acetylene was 220 c.c., and 52 grams of bromobenzene were employed. The acetylene, dried with phosphorus pentoxide, was passed through successive portions of 30 c.c. of this solution, the current of gas being continued for about 4 hours, and the flasks being kept for 2 or 3 days or longer before removing the crystals which are gradually deposited. The ethereal solution diminished to about two-thirds of its original volume during the saturation with acetylene.

The crystals, which vary considerably in size when obtained from distinct preparations, are hygroscopic and very soft; they were not recrystallised for analysis, but rapidly dried on filter paper, scraped with a sharp nickel spatula, and analysed as quickly as possible.

0·1037 gave 0·1291 AgBr. Br = 53·00.
0·0894 „ 0·048 $MgSO_4$. Mg = 10·86.
$C_8H_{21}O_3Br_3Mg_2$ requires Br = 52·86; Mg = 10·49 per cent.

The substance is decomposed by water, heat being generated during the reaction; magnesium hydroxide is precipitated, and ether is set free.

The ether was estimated by introducing a crystal into a eudiometer standing over mercury; dry oxygen and two drops of water were then added successively, the apparatus was surrounded by a steam jacket and an electric spark passed through the gaseous mixture. The carbon dioxide produced was measured by caustic potash absorption, after

decomposing any magnesium carbonate present by the addition of three drops of dilute sulphuric acid.

0·0221 gave 8·44 c.c. CO_2; $Mg_2Br_3,C_8H_{21}O_3$ requires 8·73 c.c. CO_2. Oxygen used = 13·34 c.c.; $Mg_2Br_3,C_8H_{21}O_3$ requires 13·1 c.c. oxygen.

The analyses point to the formula $Mg_2Br_3{\cdot}OH,2(C_2H_5)_2O$, and the substance doubtless owes its origin to the action of small quantities of water on the magnesium phenyl bromide, $C_6H_5MgBr + H_2O = C_6H_6 + MgBr{\cdot}OH$, the magnesium oxybromide then combining with ether and magnesium bromide; the latter is always a by-product of the action of bromobenzene on magnesium in ethereal solution, the acetylene serving merely to evaporate the ether.

Zelinsky (*Chem. Centr.*, 1903, ii, 277), by the interaction of magnesium, iodine, and ether, obtained a compound to which he assigns the formula

$$\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\!\!>\!O\!<\!\!\begin{matrix} Mg \\ I \end{matrix}\!\!>\!O\!<\!\!\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix},$$

and the compounds $MgBr_2,3(C_2H_5)_2O$, and $MgBr_2,(C_2H_5)_2O$, have also been produced. Zelinsky considers that these compounds play the *rôle* of catalysts in the formation of the mixed organo-magnesium compounds. The compound obtained by the author is evidently related to these products, and should perhaps be represented by the formula

$$\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\!\!>\!O\!<\!\!\begin{matrix} MgBr \\ Br \end{matrix}, \quad \begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\!\!>\!O\!<\!\!\begin{matrix} MgBr \\ OH \end{matrix}.$$

***26. "The arrangement in space of the groups combined with the tervalent nitrogen atom." By Frederic Stanley Kipping and Arthur Henry Salway.**

The Hantzsch and Werner hypothesis regarding the tervalent nitrogen atom indicates the existence of enantiomorphously related isomerides in compounds of the type $NR_1R_2R_3$, and one of the objects of this investigation was either to isolate, if possible, such isomerides or to demonstrate their non-existence.

Since an externally compensated acid chloride may be used for the detection of asymmetry in bases where the asymmetry is due to a carbon atom (Kipping and Hall, *Trans.*, 1901, 79, 444), it seemed probable that, if tervalent nitrogen compounds were asymmetrical, their asymmetry could be detected in like manner, but no evidence of the existence of isomerides was obtained on examining the products of the interaction of *dl*-benzylmethylacetyl chloride with methylaniline, *p*-toluidine, benzylaniline, and phenylhydrazine. *p*-Toluidine and

benzylaniline also gave negative results with optically active benzylmethylacetyl chloride. Although the introduction of one centre of asymmetry failed to afford separable isomerides, it seemed highly probable that the introduction of a second centre of asymmetry would give a satisfactory result if enantiomorphously related derivatives of tervalent nitrogen were really capable of existence. The products from *d*-benzylmethylacetyl chloride and *l*-menthylamine, *d*-hydrindamine, *l*-methylhydrindamine, and *l*-phenylethylamine, however, retained their uniform character after fractional crystallisation. These results indicate that the three radicles, together with the tervalent nitrogen itself, are situated in one plane; that two of the radicles are symmetrically arranged with respect to the third, and that in all probability this is true of any two, that is to say the whole arrangement is the most symmetrical one possible.

The substituted amides derived from the interaction of benzylmethylacetyl chloride and the foregoing inactive and active bases were described.

Assuming that the isomerism of the syn- and anti-forms of oximes is structural and represented by the formulæ $\begin{matrix}R\\R_1\end{matrix}\!>\!C{:}NOH$ and $\begin{matrix}R\\R_1\end{matrix}\!>\!C\!<\!\begin{matrix}NH\\|\\O\end{matrix}$, the latter structure, since it contains an asymmetric carbon atom, should exist in enantiomorphously related forms, and the introduction of an optically active acid chloride should produce two non-enantiomorphously related separable isomerides. The action of benzylmethylacetyl chloride on benzoinoxime was studied, but instead of the desired acyl derivative, the following products were obtained: benzil, benzoin, benzaldehyde, benzonitrile, ammonium chloride, hydrogen chloride, and benzylmethylacetic acid, together with a compound melting at 126°. Attempts to obtain a benzylmethylacetyl derivative from α-benzaldoxime were also unsuccessful, decomposition taking place with the formation of benzonitrile.

Benzoyl chloride interacts normally with benzoinoxime, giving *benzoinoxime benzoate*, $CHPh(OH)\cdot CPh{:}NOBz$, which crystallises from alcohol in leaf-like plates melting at 165—166°.

Benzoylbenzoinoxime, $CHPh(OBz)CPh{:}NOH$, prepared by treating benzoylbenzoin with hydroxylamine, crystallises from alcohol in globular clusters melting at 148°.

dl-Benzylmethylacetyl chloride gives, with *dl*-hydrindamine, two isomeric *dl*-benzylmethylacetohydrindamides, which can be easily separated; these two compounds melt at 110—111° and 119·5° respectively, and their formation affords proof of the asymmetry of the hydrindamine molecule.

d-Benzylmethylacetyl chloride and *dl*-hydrindamine give a mixture

of the isomeric amides *dAdB* and *dAlB*, from which the derivative of the *d*-base is easily isolated; the enantiomorphously related components of *dl*-α-phenylethylamine may be separated in a similar manner, the compound, $CH_2Ph{\cdot}CHMe{\cdot}CO{\cdot}NH{\cdot}CHMePh$, of the *l*-base being easily isolated.

27. "The esterification of *r*-mandelic acid by menthol and borneol." By Alexander McKenzie.

The results recorded in this research deal with the method of resolving *i*-compounds devised by Marckwald and the author (*Ber.*, 1899, **32**, 2130; 1900, **33**, 208; 1901, **34**, 469. Compare Walden, *Ber.*, 1899, **32**, 2703; E. Fischer, *Ber.*, 1899, **32**, 3617).

When *r*-mandelic acid was heated with *l*-borneol, the unesterified acid was lævorotatory, whilst the mixture of esters yielded a lævorotatory acid. When *l*-bornyl *dl*-mandelate was submitted to fractional hydrolysis, a lævorotatory acid was obtained from the initial hydrolysis, and an inactive acid from the final hydrolysis of the residual esters by an excess of alcoholic potassium hydroxide. *d*-Mandelic acid was isolated from the dextrorotatory acid obtained from the initial hydrolysis of *l*-menthyl *dl*-mandelate. *l*-Menthyl *dl*-mandelate can yield either a dextrorotatory or a lævorotatory acid from the initial fractional hydrolysis according to the amount of alkali used. *l*-Menthyl *dl*-mandelate boils at 225° under 30 mm. pressure and melts at 85—86°; it has $[\alpha]_D^{18°} -74{\cdot}2°$ ($c = 10{\cdot}890$) in ethyl-alcoholic solution; it is partially racemic, and is not resolved into *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate when repeatedly crystallised from light petroleum at the temperature of the laboratory. Potassium *l*-mandelate is completely racemised when heated with a large excess of potassium hydroxide in aqueous or ethyl-alcoholic solution.

28. "Certain organic phosphorus compounds." By Augustus Edward Dixon.

In pursuing the study of the interaction of phosphorus halides with metallic thiocyanates (*Trans.*, 1901, **79**, 541), the author has now succeeded in isolating phosphorus and phosphoryl "thiocyanates" respectively.

Phosphorus trithiocyanate, $P(CNS)_3$, obtained from phosphorus trichloride and dry ammonium thiocyanate in presence of benzene, is an almost colourless oil boiling at 163° under 15 mm. pressure, and having a sp. gr. 1·487 at 15·5°. When treated with water, a portion was quickly hydrolysed, forming phosphorous and thiocyanic acids;

the remainder was hydrolysed exceedingly slowly, but otherwise no material difference in properties or composition was observed between this residue and a distillate not subjected to the action of water.

Phosphoryl trithiocyanate, $PO(CNS)_3$, obtained from phosphorus oxychloride, is a clear, pale yellow, highly refractive oil, boiling at 175° under 21 mm. pressure, and completely hydrolysed by cold water into phosphoric and thiocyanic acids, together with some *iso*perthiocyanic acid, resulting from the interaction of these products; it has a sp. gr. 1·520 at 13·5°.

These substances not only behave as thiocyanates, but also, to some extent, manifest the properties of thiocarbimides, being freely desulphurised by alkaline salts of lead and silver; they unite spontaneously with aniline, &c., fixing either one or three molecular proportions, according to the amount presented, to form amorphous solids, insoluble in cold water. The additive products are readily hydrolysed by contact with hot water, yielding in all cases approximately one molecular proportion of monosubstituted thiourea; a little hydrogen sulphide is evolved, but otherwise the rest of the contained sulphur appears as thiocyanic acid.

Certain tests which have been employed to distinguish between thiocyanates and thiocarbimides (such as treatment of the alcoholic solution with sodium, or the action of thioacetic acid) cannot be safely accepted as final where acyl thiocyanates are concerned, all the latter so far examined being tautomeric in the sense that, under suitable conditions, they can behave as thiocarbimides to a greater or less extent if their power in this direction is measured by their capacity to fix aniline in the form of an immediate derivative of normal phenylthiocarbamide.

The study of these supposed tautomeric phenomena is being continued.

29. "Note on the relation between the chemical composition of some organic substances and the density of their solutions." By Charles Edward Fawsitt.

The density of aqueous solutions of different salts in equivalent quantities is an additive property, and the principal relations are given by Valson's Law of Moduli. The relation of density in solutions of organic compounds (feeble electrolytes or non-electrolytes) to chemical composition or constitution is not yet so fully understood.

The author, in continuing an investigation on the amides (*Proc. Roy. Soc. Edin.*, 1904, 25, 51), has measured the density of aqueous solutions of a number of amides at 25°, when the solutions contained

the gram-molecular weight of the substance dissolved in one litre The densities of urea, methylurea, and *as*-dimethylurea solutions are 1·0155, 1·0137, and 1·0107 respectively; a comparison of these numbers with those obtained by Kanitz (*Zeit. physikal. Chem.*, 1897, 22, 336) for ammonia, methylamine, and dimethylamine, namely, 0·9932, 0·9886, and 0·9856, shows that the differences for the corresponding numbers are fairly close to one another.

The densities of solutions of acetamide, propionamide, and butyramide are 1·0040, 1·0028, and 1·0006.

The values obtained for acetic, propionic, and butyric acids by Reyher (*Zeit. physikal. Chem.*, 1888, 2, 744) are 1·0084, 1·0066, and 1·0040, and show a similar relationship.

From these results, it will be seen that the density of such solutions is to a great extent an additive property, but constitution also plays some part, because isomeric substances give different values.

30. "The so-called 'hydrocellulose.'" By Arthur Landauer Stern.

When cellulose is exposed to the action of dilute acids under certain conditions, the tenacity of the fibres is destroyed, and it falls to a powder which has been called hydrocellulose, and stated to have the empirical formula $C_{12}H_{22}O_{11}$.

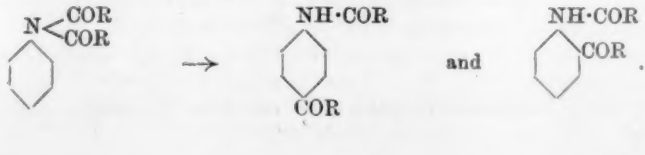
It is now shown that when the above reaction takes place, instead of a gain in weight, as theory indicates, there is invariably a loss, and that a small amount of soluble matter is formed, a portion of which, in all probability, is *d*-glucose.

The elementary composition of the powder is also shown to be identical with that of cellulose, the previous statements bearing on this point being founded on faulty experimental methods.

A hydrated cellulose is not formed under these conditions, but a hydrolysis takes place similar to that undergone by other carbohydrates under comparable conditions.

31. "Isomeric change of diacylanilides into acylaminoketones." By Frederick Daniel Chattaway.

When the diacylanilides are heated in presence of hydrogen chloride or zinc chloride, intramolecular rearrangement takes place and the isomeric acylaminoketones are produced thus:



Such isomeric changes as have been studied follow an exactly similar course to that of other analogous transformations in which atoms or groups of atoms pass from the nitrogen into an ortho- or para-position in the ring.

The introduction of a second acyl group into the nucleus has, however, not yet been effected (compare *Proc.*, 1902, **18**, 173; 1903, **19**, 50, 57, 106, 124).

32. "Intramolecular rearrangement in derivatives of the aromatic aminoketones." By Frederick Daniel Chattaway.

The acylchloroamino-derivatives of the aromatic ketones readily undergo the intramolecular rearrangement characteristic of substituted aromatic chloroamines in which the halogen linked to the nitrogen changes place with a hydrogen atom attached to the ring in an ortho- or para-position. The conditions necessary for the transformations to take place were indicated, and a series of new aromatic chloroaminoketones with their acyl derivatives was described.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday, March 23rd**, at **half-past five** o'clock in the afternoon.

At the next Meeting, on **Thursday**, March 3rd, 1904, at **8** p.m., the following papers will be communicated:—

"Chemical dynamics of the alkyl iodides." By K. A. Burke and F. G. Donnan.

"The constitution of phenolphthalein." By A. G. Green and A. G. Perkin.

"δ-Ketohexahydrobenzoic acid." By W. H. Perkin, jun.

"Photochemically active chlorine." By C. H. Burgess and D. L. Chapman.

"The separation of β-crotonic acid from α-crotonic acid." By R. S. Morrell and A. E. Sellars.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 11/3/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 277.

Thursday, March 3rd, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. W. W. Underhill and J. A. Goodson were formally admitted Fellows of the Society.

THE PRESIDENT announced that arrangements had been made for the delivery of a Faraday Lecture this year. The invitation addressed in the first instance to Professor Emil Fischer had been accepted and a date in November last had been selected for the lecture, but to the great regret of the Council the state of Professor Fischer's health had prevented him from fulfilling his engagement. Professor Ostwald, of Leipzig, had, however, been good enough to accept an invitation to give the lecture on April 19th next, and by the courtesy of the authorities of the Royal Institution the discourse would be delivered in the Theatre of that Institution. Arrangements as to the admission of Fellows of the Society would be announced later in the Proceedings.

Certificates were read for the first time in favour of Messrs.

Robert S. Finlow, Pemberandah, Dalsingh Serai, India.
Robert de J. Fleming-Struthers, B.A., Exeter College, Oxford.
George Mathieson Horn, Ivylands, Epping.
Alfred Mander, Berkswell, Malvern.
Gerald Pinchbeck, 96, Albany Street, Regents Park, N.W.
Walter Tong, Pole Lane, Failsworth, Manchester.

Of the following papers, those marked * were read:

***33. "Chemical dynamics of the alkyl iodides." By Miss Katherine A. Burke and Frederick George Donnan.**

The reactions between silver nitrate and certain of the alkyl iodides in absolute alcoholic solutions were shown to be very complicated, and the main conclusions deduced are summarised as follows:

1. The reactions between silver nitrate and an alkyl iodide in absolute alcohol at 24·5° and at concentrations varying from $N/20$ to $N/80$ can be expressed by a special form of the bimolecular velocity-equation, in which the velocity-coefficient is a function of the initial concentration of the reacting components.

2. It is found that in solutions containing the reagents in equivalent amounts, the velocity-coefficient (k) increases as the initial molecular concentration (c) increases, the relation between k and c being $k = Kc^{0·58}$, where K is independent of concentration.

3. This variation of k is chiefly due to the silver nitrate. For solutions containing the same ($N/40$) initial concentration of ethyl iodide and varying ($N/20$—$N/80$) initial concentration (c) of silver nitrate, the relation between k and the latter is approximately $k = Kc^{\frac{1}{2}}$. For solutions containing the same initial concentration of silver nitrate and varying initial concentration of ethyl iodide, the value of k decreases as the latter increases, but the rate of decrease is relatively small as compared with the rate of increase produced by silver nitrate.

4. It has not been found possible to explain the variation of k indicated in 1, 2, and 3. In particular, the assumption that it is the silver ions which take part in the fundamental reaction which regulates the speed does not appear to offer a simple explanation.

5. Similar anomalies have been observed by Hecht, Conrad, and Brückner in the case of ether-formation from sodium alkyloxide and alkyl iodide in alcoholic solution, but the explanation of these anomalies proposed by Steger, based on assumptions concerning the ionisation of the sodium alkyloxide in alcoholic solution, does not appear to be valid if the ordinary law of equilibrium is assumed.

6. The theory of "alkylene" and "alkylidene" dissociation of the alkyl iodides, proposed by Nef, does not give a satisfactory account of the observed results.

7. As stated by Nef, nitric acid is the only acid produced in the reaction. Chiminello's statement that acetic acid is formed appears

to be incorrect. The other products of the reaction are ether and alkyl nitrate.

8. If the reactivities of the alkyl iodides are measured by the velocity-coefficients of the reaction with silver nitrate in absolute alcohol ($N/40$ equivalent solutions at 24·5°), the order of reactivity (beginning with the greatest) is *iso*propyl, ethyl, *n*-propyl, methyl, *n*-butyl, *iso*amyl, *iso*butyl.

9. This order of reactivities corresponds with the rate of production of free iodine in the alcoholic solutions when exposed to air and light, with the single exception of methyl iodide, the solution of which becomes discoloured at a rate between those of solutions of *iso*propyl and ethyl iodides.

10. The relative reactivities referred to in (8) do not agree in many respects with those observed in other reactions which have been studied kinetically, such as the reactions with ethyl sodioacetoacetate, triethylamine, sodium alkyloxide. Compared with these results, *iso*propyl iodide reacts with abnormally great, and methyl iodide with abnormally small velocity. It does not appear possible, therefore, to ascribe the reactivity of the alkyl haloids to any uniform cause (such, for example, as a dissociation, whether "alkylidene," "alkylene," or electrolytic).

11. So far as the final products and not the kinetics of the reaction are concerned, the production of ether and nitric acid can be explained by ionic reactions just as well as by Nef's hypothesis.

*34. "Separation of β-crotonic acid from α-crotonic acid." By Robert Selby Morrell and Albert Ernest Bellars.

The separation of β-crotonic acid from α-crotonic acid was formerly effected by means of the different solubilities of the sodium salts in alcohol (Michael and Schulthess, *J. pr. Chem.*, 1892, [ii], 46, 245), the β-crotonate being more soluble in absolute alcohol than its α-isomeride. The β-crotonic acid thus obtained was considered by J. Wislicenus to be not entirely free from the α-acid (*Chem. Centr.*, 1897, ii, 259).

The salts of β-crotonic acid with brucine and quinine have been found to be less soluble than the corresponding derivatives of α-crotonic acid. The brucine salts are unfortunately very soluble in most solvents, but the quinine salts are very sparingly soluble in water, and it is easy to separate quinine β-crotonate (m. p. 157°) from quinine α-crotonate (m. p. 134°) by fractional crystallisation; the solubility of the β-crotonate in water at 17° is 1·0, whilst that of the α-crotonate is 2·4 at the same temperature, and two crystallisations are sufficient to complete the separation.

The barium β-crotonate, $Ba(C_4H_5O_2)_2,H_2O$, obtained from the quinine salt, when suspended in pure ether and decomposed by dilute sulphuric acid, yielded the pure β-crotonic acid (m. p. 15°, sp. gr. 1·0342 at 12·5°). Its physical and chemical properties agree with those described by Michael and by J. Wislicenus (*loc. cit.*). The molecular weight in glacial acetic acid is 85·6, and the molecular refraction is 37·2.

The advantage of the following method of separation lies in the fact that fractional distillation of the two acids is avoided, and it is easier to obtain the less soluble quinine β-crotonate in a pure state than to remove sodium α-crotonate completely from the more soluble sodium β-crotonate.

***35. "Contributions to the knowledge of the β-diketones." By Siegfried Ruhemann and Edwin Roy Watson.**

The authors have repeated Wislicenus's experiments on the action of alcoholic potash in benzylideneacetophenone dibromide and find that the compound produced has the empirical formula $C_{17}H_{16}O_2$, and not $C_{15}H_{12}O_2$, as stated by Wislicenus (*Annalen*, 1899, 308, 219), and that it is the ethyl ether of dibenzoylmethane, $C_6H_5\cdot C(O\cdot C_2H_5):CH\cdot CO\cdot C_6H_5$. Under the influence of hydrochloric acid, the substance decomposes into ethyl chloride, acetophenone, and benzoic acid.

Alcoholic potash behaves similarly towards the dibromide of *p*-nitrobenzylideneacetophenone, $C_6H_4(NO_2)\cdot CHBr\cdot CHBr\cdot CO\cdot C_6H_5$, yielding the ethyl ether of *p*-nitrodibenzoylmethane,

$$C_6H_4(NO_2)\cdot C(O\cdot C_2H_5):CH\cdot CO\cdot C_6H_5$$

(m. p. 89—90°).

The authors have also examined the action of ammonia and organic bases on the olefinic diketones. Thus benzylideneacetylacetone reacts with aniline to form the compound $C_6H_5\cdot CH(NH\cdot C_6H_5)\cdot CH(CO\cdot CH_3)_2$ (m. p. 113°). This, on heating, decomposes into benzylideneaniline and acetylacetone. Phenylhydrazine reacts with benzylideneacetylacetone and also with benzylidenebenzoylacetone with evolution of heat. The additive compounds could not be obtained, since, in each case, they are decomposed at once with the formation of benzaldehyde phenylhydrazone.

With benzylideneacetylacetone, alcoholic ammonia forms the compound $C_{19}H_{20}ON_2$ (m. p. 147°), which is to be regarded as acetyldiphenylmethyltetrahydropyrimidine, $C_6H_5\cdot CH\begin{<}\begin{matrix}C(CO\cdot CH_3):C(CH_3)\\ NH\text{——}CH(C_6H_5)\end{matrix}\end{>}NH$.

The diketones react with semicarbazide with the elimination of 1 molecule of water and the formation of $C_{13}H_{15}O_2N_3$ (m. p. 210° with decomposition) and $C_{18}H_{17}O_2N_3$ (decomposing at 230°). These compounds may be regarded as semicarbazones, but taking into

consideration the behaviour of other bases towards the diketones, the alternative view of representing them as cyclic compounds cannot be disregarded.

The additive compound obtained from benzamidine and benzylidenebenzoylacetone (*Trans.*, 1903, 83, 1372) may also be regarded as being formed by the addition of the base to the ethylenic linking of the olefinic ketone.

***36. "The purification of water by continuous fractional distillation." By William Robert Bousfield.**

An apparatus was described in which water is distilled continuously from a copper boiler, freed from spray by means of a system of baffle plates, and condensed on surfaces kept at different temperatures by an adjustable supply of cold water. The hottest surfaces yield distilled water of ordinary quality, whilst the coldest surfaces give water of conductivity 1 to 2 reciprocal megohms per c.c., which is sufficiently pure for the majority of conductivity measurements, and contains only a small proportion of ammonia.

***37. "Freezing point curves of dynamic isomerides. Ammonium thiocyanate and thiocarbamide." By Alexander Findlay.**

The author has studied the equilibrium relations of the dynamic isomerides, ammonium thiocyanate and thiocarbamide from the point of view of the phase rule, attention being directed chiefly to the determination of the freezing points of mixtures of these substances with the view of ascertaining what compounds, if any, are formed at temperatures in the neighbourhood of the freezing points, and the conditions of their stability (compare Emerson Reynolds and Werner, *Trans.*, 1903, 83, 1). The freezing point curve obtained is of the simplest form, consisting of two branches meeting at a eutectic point which lies about 104·3°. The melting points of ammonium thiocyanate and of thiocarbamide can be determined only approximately on account of the occurrence of isomeric transformation. The melting point of ammonium thiocyanate may be taken as being about 149° and that of thiocarbamide as not lower than 175—177°, these being determined by comparison with camphor. The natural freezing point is 114—115°, the stable form being ammonium thiocyanate. From the simple form of the freezing point curve obtained, it follows that no compound is formed which is stable at the temperatures indicated on this curve. This conclusion is supported by the form of the cooling curve and by the analysis of the solid phase.

From the fact that the equilibrium point in the liquid phase is independent of the temperature, it follows that the isomeric transformation is not accompanied by any heat effect.

38. "The constitution of phenolphthalein." By Arthur George Green and Arthur George Perkin.

The authors have found that a solution of phenolphthalein, decolorised by an excess of caustic alkali, can be entirely neutralised, without any return of the colour taking place, by careful titration at a low temperature with dilute acetic acid. If, however, the colourless neutral solution is boiled, the red colour returns in its full intensity, whilst at the same time the solution becomes alkaline. If the solution is acidified and either left for some time or heated, a precipitation of free phenolphthalein occurs, which also dissolves in aqueous alkalis to a red solution. The point at which neutrality occurs in the titration with acetic acid corresponds with the presence in the colourless solution of the carbinolcarboxylic acid salt,

$$C_6H_4(CO_2M)\cdot C(OH)(C_6H_4\cdot OH)_2.$$

These observations do not agree with the electrolytic dissociation hypothesis, but are simply explained by the quinonoid theory if the colour changes are attributed to a variation of type from a quinonoid to a benzenoid form and *vice versâ*, due to hydration and dehydration.

Thus, the first action of an alkali on the free phenolphthalein (lactone) would probably be the replacement of the phenolic hydrogen by the alkali metal. This salt being unstable may be supposed to undergo immediate transformation into the coloured quinonoid salt, $C_6H_4(CO_2K)\cdot C(C_6H_4\cdot OH):C_6H_4:O$, by direct transference of the metal from the phenolic to the carboxylic group.

With excess of caustic alkali, this coloured salt is converted, by assumption of KOH, into the colourless carbinol salt, $C_6H_4(CO_2K)\cdot C(OH)(C_6H_4\cdot OH)\cdot C_6H_4\cdot OK$, and this product, when neutralised with acetic acid, gives $C_6H_4(CO_2K)\cdot C(C_6H_4\cdot OH)_2\cdot OH$, which is also colourless. Caustic potash is set free on boiling the latter salt, and the lactone, $CO\langle\begin{smallmatrix}O\\C_6H_4\end{smallmatrix}\rangle C(C_6H_4\cdot OH)_2$, which is produced is simultaneously converted into the coloured quinonoid salt by the liberated alkali.

A similar explanation is offered in the case of quinolphthalein, the behaviour of which is found to be exactly similar to that of phenolphthalein.

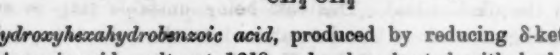
39. "δ-Ketohexahydrobenzoic acid." By William Henry Perkin, jun.

Ethyl γ-cyanopentane-αγε-tricarboxylate,

$$CO_2Et\cdot C(CN)(CH_2\cdot CH_2\cdot CO_2Et)_2,$$

is readily prepared by the interaction of ethyl β-iodopropionate with the sodium compound of ethyl cyanoacetate; it boils at 228° under 20 mm. pressure, and, on hydrolysis with hydrochloric acid, yields pentane-αγε-tricarboxylic acid, $CO_2H\cdot CH(CH_2\cdot CH_2\cdot CO_2H)_2$ (compare Emery, *Ber.*, 1891, **24**, 384; Bottomley and Perkin, *Trans.*, 1900, **77**, 299). On digesting this acid with acetic anhydride and distilling the product under diminished pressure, water and carbon dioxide are eliminated, and *δ-ketohexahydrobenzoic acid* (cyclo*hexanone*-4-*carboxylic acid*) is produced, which crystallises with one molecule of water, melts at 68°, and distils at 210°/30 mm. It was further characterised by means of its *oxime*, *semicarbazone*, and *methyl* and *ethyl* esters.

The ketonic acid forms an oily phenylhydrazone, which, on heating with hydrochloric acid, yields *tetrahydrocarbazole*-p-*carboxylic acid* (m. p. 195°) (compare Baeyer and Tutein, *Ber.*, 1889, **22**, 2184). δ-Ketohexahydrobenzoic acid, when digested with methyl alcohol and sulphuric acid, yields *ethyl carboxyhexamethenyl-δ-ketohexahydrobenzoate* (b. p. 255°/20 mm.). This ester, on hydrolysis, yields the acid, which melts at 170° and has the following constitution:



trans-*Hydroxyhexahydrobenzoic acid*, produced by reducing δ-ketohexahydrobenzoic acid, melts at 121°, and, when heated with hydrobromic acid, is converted into trans-*δ-bromohexahydrobenzoic acid* (*bromo*cyclo*hexane*-4-*carboxylic acid*) (m. p. 167°), and this, when digested with sodium carbonate, loses hydrogen bromide, yielding Δ^3-*tetrahydrobenzoic acid*, which melts at about 13° and distils at 237°/748 mm.; it combines with hydrobromic acid to form *γ-bromohexahydrobenzoic acid* (m. p. 122°), and also absorbs bromine at the ordinary temperature, yielding *γδ-dibromohexahydrobenzoic acid* (m. p. 86°).

δ-Ketohexahydrobenzoic acid combines with hydrogen cyanide, and from the product, the *nitrile* of trans-*α-hydroxyhexahydroterephthalic acid*, $OH\cdot C(CN)[CH_2\cdot CH_2]_2\cdot CH\cdot CO_2H$, was isolated in the form of pale yellow crystals melting at about 140°. This nitrile yields, on hydrolysis, trans-*α-hydroxyhexahydroterephthalic acid* (m. p. 228—230°). If the crude product of the action of hydrogen cyanide on ketohexahydrobenzoic acid is hydrolysed, the principal product obtained is *α-hydroxyhexahydroterephthalic acid* (m. p. 168—170°).

Both *cis*- and *trans*-hydroxy-acids are decomposed on distillation,

with loss of water and formation of Δ^1-*tetrahydroterephthalic acid* (Baeyer, *Annalen*, 1888, 245, 160).

The investigation of δ-ketohexahydrobenzoic acid is being continued.

40. "Photochemically active chlorine. A preliminary notice." By Charles Hutchens Burgess and David Leonard Chapman.

By taking advantage of several new facts, the authors have succeeded in showing that the activity of a mixture of hydrogen and chlorine depends entirely on the condition of the chlorine. Draper originally maintained that this was the case, but Bunsen and Roscoe were unable to repeat his experiments, and Mellor, accepting the results of Bunsen and Roscoe, has constructed his working hypothesis on the assumption that Draper is wrong. P. V. Bevan (*Phil. Trans.*, 1903, 202, 71) has quite recently shown that similar mixtures of hydrogen with insolated and uninsolated chlorine exposed to light under the same conditions behave somewhat differently, the period of induction of the former being slightly shorter. The work of Bevan shows that before hydrochloric acid can be formed some change in the chlorine alone must take place, but it may also be necessary for a further change to occur which can only be effected in the presence of hydrogen, or, in terms of this author's hypothesis, it may first be necessary for complex molecules of chlorine and water to be formed, and then for the hydrogen to react with these forming complexes containing water, chlorine, and hydrogen, both changes requiring a finite time for their completion.

That a saturated solution of chlorine in water can exist either in an active or in an inactive condition is shown in the following way. A mixture of hydrogen and chlorine contained in a Bunsen and Roscoe's actinometer was exposed to light until the period of induction was passed. It was then vigorously shaken so as to mix the gas and liquid thoroughly. When the mixture was again exposed to light, a second period of induction was observed, which, however, was not so long as the first. A still shorter period of induction was indicated when the mixture had again been shaken, until after repeating the above process several times no difference could be noticed in the rate of combination before and after shaking, thus proving that the liquid in the bulb had become active. The change which precedes the formation of hydrogen chloride undoubtedly extends to the aqueous solution.

It was next shown that a mixture of hydrogen and chlorine which had passed through the period of induction could again be rendered inactive by shaking the mixed gases with either water, hydrochloric acid, hypochlorous acid, or chlorine water, and further that a mixture

of hydrogen and chlorine which had been agitated with water showed a much longer period of induction than one which had not been thus treated.

An apparatus was devised into which chlorine could be passed and treated in any desired manner before being mixed with hydrogen. Into this apparatus, chlorine was passed and shaken with water. The chlorine water thus formed was removed, and the gas again shaken with a fresh supply of water, the operation being repeated several times. The chlorine which had been thus treated was then mixed with an equal volume of hydrogen and exposed to light, when the period of induction lasted for over an hour.

In the next experiment, the chlorine was constantly shaken with the liquid contained in the apparatus and exposed to a strong light in order to render both the liquid and the gas active; the gas was then mixed with hydrogen in the dark and exposed to light. There was no period of induction; combination of hydrogen and chlorine took place immediately, and no variation in the rate of combination could be observed throughout the reaction.

These results indicate (1) that a solution of chlorine exists either in an active or in an inactive state; (2) that the period of induction is entirely due to the condition of the chlorine.

41. "The union of hydrogen and chlorine. VIII. The action of temperature on the period of induction." By Joseph William Mellor.

Measurements of the duration of the period of induction at different temperatures from 3° up to 50° show (i) that the period is shorter the higher the temperature; (ii) that above 38°, disturbing effects, probably due to the presence of water vapour, obscure the influence of the increased temperature.

42. "The union of hydrogen and chlorine. IX. Further experiments on the action of light on chlorine." By Joseph William Mellor.

Bevan has recently shown that the activity of chlorine after exposure to sunlight, first observed by Draper, is destroyed by bubbling the chlorine through water, as in Bunsen and Roscoe's experiment. Bevan supposes that the union with hydrogen still proceeds through the intervention of the intermediate compound, $x\mathrm{Cl}_2,y\mathrm{H}_2\mathrm{O},z\mathrm{H}_2$, as suggested in the author's paper (*Trans.*, 1902, 81, 1280). Two bulbs of ordinary moist chlorine were exposed to sunlight for ten minutes and afterwards mixed with moist hydrogen. The duration of the period of induction

with this mixture was compared with that of a similar mixture made in darkness. Two more bulbs of chlorine, dried with phosphoric oxide, were treated in exactly the same way. The periods of induction were relatively as follows, the expansion being corrected for the Budde effect.

Standard	Moist	Dry
1	0·5	1·0
1	0·3	0·9

The results show that the greater chemical activity of insolated chlorine is intimately associated with the presence of steam. The alternative hypothesis, put forward in the above-cited paper, is just as satisfactory as the intermediate compound theory.

43. "Additive compounds of unsaturated cyclic ketones with hydrogen cyanide." By Archie Cecil Osborne Hann and Arthur Lapworth.

The applicability of the general method for bringing about the addition of hydrogen cyanide to the ethylenic union in $\alpha\beta$-unsaturated ketones, nitriles, &c., recently worked out by one of us (Trans., 1903, 83, 999), is being systematically investigated, particularly with regard to the open chain and cyclic ketones and aldehydes.

Carvone, in presence of potassium cyanide, unites with one molecular proportion of hydrogen cyanide in the cold. The product, which is formed in nearly quantitative amount, is a *nitrile*, $C_{10}H_{15}O\cdot CN$, melting at 93·5—94·5°, which, on hydrolysis, yields two isomeric unsaturated *acids*, $C_{10}H_{15}O\cdot CO_2H$, melting at 137° and 96—97°. The foregoing nitrile gives a *cyanohydrin*, $CN\cdot C_{10}H_{15}(OH)\cdot CN$, melting at 106—108°, which is easily hydrolysed, forming the *acids* $C_{12}H_{17}O_3N$ and $C_{12}H_{16}O_4$, which are possibly mixtures of isomerides.

Pulegone behaves somewhat similarly; the first additive product is the *nitrile*, $C_{10}H_{17}O\cdot CN$, which melts at 160·5°.

A number of other derivatives of the foregoing compounds have been obtained, and will be described in due course.

44. "The formation of periodides in organic solvents." By Harry Medforth Dawson.

The formation of potassium periodides in various organic solvents has been studied by determining the composition of such solutions when saturated either with potassium iodide or with iodine.

The aromatic nitro-compounds investigated, such as nitrobenzene, *o*-nitrotoluene, *m*-nitrotoluene and *o*-nitroanisole, show a very similar

behaviour, and under conditions favourable to the formation of the highest possible periodide, namely, saturation of the solution with regard to iodine, the enneaiodide, KI_9, is the essential component of the solutions. The composition of the solutions saturated with respect to potassium iodide indicates that increasing concentration favours the formation of periodides of gradually increasing complexity.

By a method devised for the study of solid aromatic nitro-compounds, it is shown that these exert an influence on the formation of soluble periodides which is in many respects similar to that of nitrobenzene.

Other solvents, including nitromethane, nitropentane, ethyl alcohol, propionitrile, ethyl acetate, ethyl bromide and *iso*butyl alcohol, have also been investigated.

45. **"The action of sodium hypochlorite on the aromatic sulphonamides." By Henry Stanley Raper, John Thomas Thompson, and Julius Berend Cohen.**

The authors have continued the investigation described in the preliminary notice published in the *Proceedings* (1901, 17, 262), and have added the following facts.

Benzenesulphon-o-toluidide (m. p. 123—124°), when dissolved in acetic acid and treated with sodium hypochlorite, yields the *chloroamide*, $C_7H_7\cdot NCl\cdot SO_2\cdot C_6H_5$, melting at 99—100°; this product, on heating with acetic acid, gives benzenesulphon-5-chloro-*o*-toluidide (m. p. 124—125°). *Benzenesulphon-m-toluidide* (m. p. 95°) gives a sodium compound, $C_6H_3Cl(CH_3)\cdot NNa\cdot SO_2\cdot C_6H_5$, melting at 275—280°, which is decomposed by acetic acid and yields benzenesulphon-6-chloro-*m*-toluidide. With an excess of hypochlorite, benzenesulphon-2 : 6-dichloro-*m*-toluidide (m. p. 114°) is formed. *Benzenesulphon-p-toluidide* forms benzenesulphon-3-chloro-*p*-toluidide (m. p. 110°).

Benzenesulphon-4-m-xylidide (m. p. 124—125°) gives benzenesulphon-5-chloro-4-*m*-xylidide (m. p. 148—149°) when heated with the hypochlorite solution at 50°.

Benzenesulphon-α-naphthalide (m. p. 168°) is quite unaffected by the hypochlorite even on warming. *Benzenesulphon-β-naphthalide* (m. p. 97—98°) forms a sodium compound, which, when decomposed with acid, gives benzenesulphon-1-chloro-β-naphthalide (m. p. 130—131°).

Chattaway and Orton have shown that by the action of sodium hypochlorite on the acyl derivatives of the aromatic amino-compounds, the halogen in the first instance enters the ring in the para-position with respect to the amino-group, and then selects the ortho-position. The orienting effect of the sulphonic group is different. The foregoing results show that in the first instance the halogen seeks the ortho-

position with respect to the amino-group. If a methyl group is present and if the para-position to the amino-group is free, the conditions are modified and the halogen enters either the ortho-position to the methyl radicle or the para-position to the amino-group. It is interesting to note that the action of the hypochlorite is retarded in the *o*-substituted sulphonamides; those of *o*-toluidine and xylidine react with difficulty, whilst that of α-naphthylamine, which may be regarded as an ortho-substituted compound, is quite unchanged.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday**, March 23rd, at **half-past five** o'clock in the afternoon.

THE FARADAY LECTURE.

The Faraday Lecture will be delivered by Professor W. Ostwald on **Tuesday**, April 19th, at **8.30** p.m.

This Lecture will be delivered, by the kind permission of the managers, in the theatre of the Royal Institution, 21, Albemarle Street, W.

Admission will be by ticket only. Full particulars will be given in the next number of the Proceedings.

At the next Ordinary Meeting, on **Wednesday**, March **16th**, 1904, at **5.30. p.m.**, the following papers will be communicated:—

"Mercuric nitrite and its decomposition by heat." By P. C. Rây.

"Note on the higher glycerides." By J. B. Hannay.

"The nature of a solution of iodine in aqueous potassium iodide." By C. H. Burgess and D. L. Chapman.

"The reduction of 2 : 6-dinitrotoluene with hydrogen sulphide." By J. B. Cohen and J. Marshall.

"Isomeric change of diacylanilides into acylaminoketones. Transformation of the dibenzoyltoluidines into the isomeric benzoylamino-methylbenzophenones." By F. D. Chattaway and W. H. Lewis.

"Acid esters of methyl substituted succinic acids." By W. A. Bone, J. J. Sudborough, and C. H. G. Sprankling.

"The action of ethyl β-iodopropionate on ethyl disodioacetylene-tetracarboxylate." By O. Silberrad.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 31/3/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 278.

Wednesday, March 16th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. L. F. Guttmann, J. H. Pollok, F. D'O. Mears, and M. Blood were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Harold S. Hammond, Government Laboratory, Kingston, Jamaica.
Laurel Cecil F. Oldfield, Lincoln College, Oxford.
William D. Page, Constitutional Club, London, W.C.
Thomas L. D. Porter, B.Sc., 161, Downsell Road, Stratford, E.
Louis John E. Riley, Port-of-Spain, Trinidad.
Henry Heron Smith, 76, Plumstead Common Road, Plumstead.

Of the following papers, those marked * were read:

***46. "Mercuric nitrite and its decomposition by heat." By Prafulla Chandra Ray.**

Mercuric nitrite, hitherto unknown, can be obtained by evaporating *in vacuo* over sulphuric acid the solution left by decomposing mercuric

chloride with silver nitrite. It occurs in groups of light yellow needles which slowly deliquesce and decompose when exposed to the air. The salt and its aqueous solution are stable when sealed up out of contact with air. The solid salt is largely decomposed by water. When heated at about 100° in a vacuum, it melts and intumesces, decomposing for the most part into mercurous nitrate and nitric oxide, but also, to a small extent, into red, crystalline mercuric oxide and the gases of decomposed nitrous anhydride. Mercurous nitrate is also the main product of the decomposition of mercurous nitrite at about 200°, but in this case the nitrate occurs principally as a pseudo-sublimate, derived from the vapours of the decomposing nitrite (*Proc.*, 1903, 19, 78; *Trans.*, 1903, 83, 491).

Discussion.

Dr. Divers said that, in order to understand the production of mercurous nitrate and nitric oxide from mercuric nitrite, it was necessary (1) to bear in mind that nitric peroxide acts freely on metallic silver to form nitrate and nitric oxide, and has no action whatever on silver nitrite, and that silver nitrate heated with nitric oxide, even at temperatures well below 200°, interacts with it to form nitrite and nitric peroxide; (2) to assume the same to be true of mercurous nitrite and nitrate; and (3) to refer to the decomposition by heat of mercurous and silver nitrites. Silver nitrite, heated only moderately, behaves almost like mercuric nitrite, except that half the silver is left in the metallic state. But when it is decomposed rapidly, the silver nitrate produced is small in quantity, most of the silver being left in the metallic state and much nitric peroxide escaping. When mercurous nitrite is heated, the ultimate products are also mercurous nitrate and nitric oxide, together with about half of the metal in the free state. But here, visibly, the first products are, for the most part at least, metal and nitric peroxide, which then, at some distance off, interact to form mercurous nitrate and nitric oxide. It can, therefore, hardly be doubted that the products of decomposition of two molecules of mercuric nitrite by heat are represented by $2Hg + 4NO_2$, which then become $(HgNO_3)_2 + 2NO$, without much loss by vaporisation at the relatively low temperature at which the salt decomposes.

***47. "Note on the higher glycerides." By James Ballantyne Hannay.**

The higher glycerides, as represented by purified stearin, olive oil, linseed oil, castor oil, cotton-seed oil, rape oil, and earth-nut oil, are all capable of entering into direct combination with lead oxide, the

new compounds being formed by heating the oils with excess of finely-divided litharge at 170° to 180° and dissolving out the product with chloroform, petroleum, or carbon tetrachloride. The substance obtained resembles wax and has no sharp melting point; it begins to soften at 120°, becomes viscous at 150° to 160°, and is quite limpid at 190°. It commences to boil and decompose at about 280°, the temperature varying a few degrees according to the oil used.

In the case of the olein derivative, the composition may be represented by the formula $C_3H_5O_3{:}Pb_3(C_{18}H_{33}O_2)_3$, where the three atoms of lead are seen to replace six atoms of hydrogen, three in molecules of glycerol, and three in those of oleic acid. This compound probably represents the first step in saponification by lead oxide. The oleic acid derivative, when dissolved in ether, is decomposed by cold water in the following manner:

$$2(C_{57}H_{104}O_6,3PbO) + 3H_2O = 2(C_3H_8O_3) + 3(C_{18}H_{33}O_2)_2Pb,PbO,$$

glycerol and a basic lead oleate being thereby produced. Lead glyceryl oleate and the corresponding stearate, linoleate, and ricinoleate resemble mercury thymyl acetate in forming a double compound with lead acetate.

The foregoing compounds are stable and not affected by fractional precipitation, neither is the lead displaced by metallic sodium, phosphoric oxide, or sulphur trioxide. The free linkings of the unsaturated glycerides were unaffected by the combination with lead oxide, for the iodine number remained unchanged.

The combination of the lead glyceryl oleate with sulphur chloride is similar to the products obtained from the unsaturated glycerides in general. An examination of the action of sulphur chloride on oils showed that with due precaution the sulphur chloride additive compound was identical in type with the substances obtained by the addition of bromine, iodine, and oxygen. The sulphur chloride saturated the free linking, thus behaving as a bivalent radicle. The oxygen absorption was determined for the same oils, and the results of all these combinations have been tabulated.

During these investigations, no evidence has been obtained of the existence of Hazura's linolenic or *iso*linolenic acid with six free linkings (with eighteen in the triglyceride); all the iodine numbers are well under the limit for pure linoleic acid with four free linkings, this deficiency being due to the presence of oleic or other acid of a more saturated type.

Experiments were made with numerous samples from which the acid had been obtained by three different methods, but only linoleic acid with four linkings was obtained, this result agreeing with that of

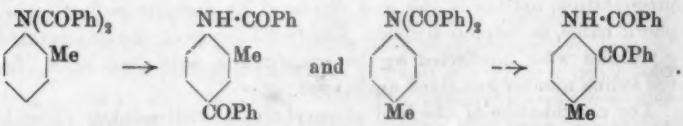
Reformatzky, who could find no evidence of the existence of acids with six free linkings.

The author showed that Hazura's method of separation with alkaline permanganate has a very variable effect, the oxidation proceeding further than the formation of hydroxy-acids. Hence it is concluded that no acid with an iodine number higher than that corresponding with four free linkings exists in natural oil.

*48. **"Isomeric change of diacylanilides into acylaminoketones. Transformation of the dibenzoyltoluidines into the isomeric benzoylaminomethylbenzophenones." By Frederick Daniel Chattaway and William Henry Lewis.**

It has been shown recently that acyl groups must be included among those which, under suitable conditions, can pass from the nitrogen of an aromatic amine into the nucleus, displacing a hydrogen atom in a para- or ortho-position relatively to the nitrogen.

An excellent illustration of this intramolecular rearrangement is furnished by the behaviour of the dibenzoyltoluidines, which at a high temperature under the influence of hydrogen chloride are converted into the isomeric benzoylaminomethylbenzophenones, thus:



In the transformation of dibenzoyl-*o*-toluidine, when the acyl group might take up a para- or an ortho-position relatively to the nitrogen, the former is assumed, apparently exclusively. In the transformation of dibenzoyl-*p*-toluidine, an ortho-position only is available.

As in the case of the analogous transformation of the acylchloroamines, interchange between the *p*-hydrogen atom and the acyl group takes place more readily than that in which the hydrogens in the ortho-positions are concerned.

The yield of *4-amino-5-methylbenzophenone* is about 50 per cent. and that of *2-amino-5-methylbenzophenone* about 20 per cent. calculated on the weight of the corresponding toluidine used.

These hitherto unknown aminoketones were described together with a number of their more important derivatives.

***49. "The action of ethyl β-iodopropionate on ethyl disodioethanetetracarboxylate." By Oswald Silberrad.**

The investigation of the interaction between ethyl β-iodopropionate and ethyl disodioethanetetracarboxylate has led to the discovery of the following new compounds:

Ethyl butane-αγγδδ-pentacarboxylate,

$$CO_2(C_2H_5)\cdot CH_2\cdot CH_2\cdot C(CO_2\cdot C_2H_5)_2\cdot CH(CO_2\cdot C_2H_5)_2,$$

boils at 215—218° under 17 mm. pressure and yields haloid derivatives which readily give rise to a lactonic acid.

Butane-αγγδδ-pentacarboxylic acid,

$$CO_2H\cdot CH_2\cdot CH_2\cdot C(CO_2H)_2\cdot CH(CO_2H)_2,$$

readily loses carbon dioxide, forming butane-αγδ-tricarboxylic acid, which melts at 122°, and not at 116—120° as previously given (Auvers, Köbner, and Megenburg, *Ber.*, 1891, **24**, 2895).

Ethyl Δ^{β}-dihydromuconate (Δ -butylenedicarboxylate),

$$CO_2(C_2H_5)\cdot CH_2\cdot CH{:}CH\cdot CH_2\cdot CO_2\cdot C_2H_5,$$

boils at 120—125° under 17 mm. pressure. The formation of this substance, which constitutes one of the minor fractions, is probably due to the condensation of two molecules of ethyl β-iodopropionate with loss of hydriodic acid.

Hexane-αγγδδζ-hexacarboxylic acid was obtained by the saponification of the corresponding ester, which, however, was not isolated in a pure condition; the constitution of the acid was established by its conversion, with loss of carbon dioxide, into hexane-αγδζ-tetracarboxylic acid, which latter appears to be identical with Sell and Easterfield's αα-diglutaric acid.

Ethyl ethylenetetracarboxylate, $(CO_2\cdot C_2H_5)_2C{:}C(CO_2\cdot C_2H_5)_2$, is also produced in small quantities, and was identified by conversion into its acid potassium salt. Its formation is probably due to the action of iodine, produced by the decomposition of ethyl β-iodopropionate, on ethyl disodioethanetetracarboxylate.

***50. "The heat of formation of glucinum chloride." By James Holms Pollok.**

This research was undertaken in order to obtain the heat of formation of glucinum chloride direct from the metal, for this constant is required in calculating the heats of formation of the other salts of glucinum from the heats of neutralisation of the various acids by the base glucina.

A sample of ground beryl from Limoges was employed in the pre-

paration of pure glucina, and this oxide was converted into the anhydrous chloride by heating with carbon (from cane sugar) in a current of dry chlorine, the metal being finally obtained from the salt by the action of metallic sodium in a nickel crucible.

On dissolving the metal in hydrochloric acid contained in a calorimeter, it was found that the heat of formation of glucinum chloride in solution was 199·5 calories. The heat of solution of the anhydrous chloride in water is 44·5 calories, and deducting this from the foregoing number, the heat of formation of dry anhydrous glucinum chloride is found to be 155 calories.

***51. "A note on the composition of distilled oil of limes and a new sesquiterpene." By Herbert Edward Burgess and Theodore Henry Page.**

The authors have isolated and identified *l*-terpineol (m. p. 35°) as forming a large proportion of the oxygenated constituents of the oil. The peculiar odour of the oil which is attached to the terpineol fraction is due to an isomeric liquid terpineol of slightly lower boiling point. A new sesquiterpene of partially olefinic nature was also identified, which boils at 131°/9 mm. and at 262—263° (uncorr.)/756 mm., in the latter case, with slight decomposition; it has a sp. gr. 0·873 at 15° and is optically inactive; n_D is 1·4935 at 15°, and 1·4910 at 19·5°. The sesquiterpene, for which the name "*limene*" is proposed, was characterised by the formation of a trihydrochloride (m. p. 79—80°); this was the only well-defined derivative obtained, and from it the hydrocarbon can be readily regenerated. The same sesquiterpene has been identified in hand-pressed lime oil and lemon oil, and the other oils of this series are being examined for it.

52. "The nature of a solution of iodine in aqueous potassium iodide." By Charles Hutchins Burgess and David Leonard Chapman.

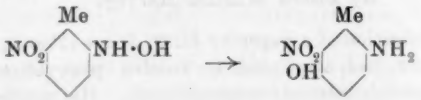
Jakowkin (*Zeit. physikal. Chem.*, 1894, 13, 529; 1896, 20, 14) has shown that the distribution of iodine between carbon disulphide and an aqueous solution of potassium iodide of varying concentration accords with the assumption of a dissociable compound KI_3. Dawson's observations (Trans., 1901, 79, 238), conducted at a different temperature, confirm this conclusion. The work of the authors has been directed towards the measurement of the relative velocities of the $\overline{I}$- and $\overline{I}_3$-ions by two independent methods; firstly, by a careful

comparison of the iodine carried over to the anode by the same current in cells containing respectively aqueous potassium iodide and a solution of iodine in aqueous potassium iodide, and, secondly, by a comparison of the conductivities of the same solutions. The mean values of the relative velocities of the $\overline{I}_3$- and $\overline{I}$-ions, determined by the first and second methods, are 0·556 and 0·553 respectively. These practically identical results, obtained by two different processes, are regarded as confirming the conclusions of previous observers.

A new and symmetrical method of writing the equilibrium equations of the foregoing solution was suggested.

53. "The reduction of 2 : 6-dinitrotoluene with hydrogen sulphide." By Julius Berend Cohen and Joseph Marshall.

In the course of an experiment in which 2 : 6-dinitrotoluene was reduced with hydrogen sulphide in alcoholic ammonia, a quantity of 2-nitro-4-amino-*m*-cresol was obtained together with 6-nitro-*o*-toluidine. The nitroaminocresol crystallises in dark orange needles, which dissolve readily in dilute acids and alkalis, and melt at 190° with decomposition; it forms colourless salts with the mineral acids and is precipitated from its solution in alkalis by carbon dioxide. On oxidation with lead peroxide and dilute sulphuric acid, it yields 2-nitrotoluquinone, which crystallises in ruby-red prisms melting at 64—65°, and is converted into 2-nitrotoluquinol by reduction with sulphur dioxide; the latter crystallises in scarlet needles melting at 117—118° and dissolving in aqueous alkalis to a violet solution. A solution of bleaching powder in the presence of hydrochloric acid converts nitroaminocresol into chloronitrotoluquinone, which crystallises in pale yellow, spear-shaped crystals melting at 70—71°. The nitroaminocresol is formed by the incomplete reduction of 2 : 6-dinitrotoluene to 6-nitro-*o*-tolylhydroxylamine in the same way that trinitrobenzene and trinitrotoluene are converted into the hydroxylamino-compounds (Cohen and Dakin, Trans., 1902, 81, 26). The hydroxylamine derivative, on boiling with dilute hydrochloric acid, changes into the corresponding *p*-aminocresol:



54. "Acid esters of methylsuccinic acids." By William Arthur Bone, John Joseph Sudborough, and Charles Henry Graham Sprankling.

The methyl hydrogen salts of succinic, *cis*- and *trans*-*s*-dimethylsuccinic, and tetramethylsuccinic acids have been obtained by the addition of methyl alcohol to the corresponding anhydrides; they melt respectively at 58°, 38°, 49° and 63°.

The methyl hydrogen salts of the unsymmetrical monomethylsuccinic, *gem*-dimethylsuccinic, and trimethylsuccinic acids have been prepared by three distinct methods: (*a*) from the anhydride, (*b*) from the neutral ester, and (*c*) from the acid. The oily products obtained by all three methods from methylsuccinic acid, give practically the same dissociation and esterification constants.

From *gem*-dimethylsuccinic acid, two distinct acid methyl esters have been obtained; one of these melts at 52° and has a lower dissociation, and also a lower esterification constant than its isomeride, which melts at 40·5°.

The methyl hydrogen salts obtained from trimethylsuccinic acid are oils, the esters obtained from the anhydride and from the acid appear to be identical, but differ from the oil obtained from the neutral ester as regards their dissociation and esterification constants. The results obtained indicate that there is no direct relationship between the two sets of constants.

The esterification constant tends to decrease with an increase in the number of methyl groups present. Walker's generalisation with respect to the dissociation constants does not hold good, as in the succinic series the ratio $\frac{K \text{ acid}}{K \text{ acid ester}}$ increases from 2·12 for succinic acid to 27·0 for tetramethylsuccinic acid. The value for a in Wegscheider's equation, $aK = Ka + K\beta$, gradually decreases from 0·945 for succinic acid to 0·074 for tetramethylsuccinic acid.

55. "A note on phenyldimethylallylammonium compounds." By Alfred William Harvey.

Before the publication of a paper by H. O. Jones (*Trans.*, 1903, **83**, 1400), the author had attempted to resolve phenyldimethylallylammonium compounds into active constituents. His results, although differing in important details, confirm the conclusions deduced by Barrowcliff and Kipping (*Trans.*, 1903, **83**, 1141) and by Jones (*loc. cit.*).

56. "**Estimation of hydrogen peroxide in the presence of potassium persulphate, by means of potassium permanganate.**" **By John Albert Newton Friend.**

A correct estimate of the amount of hydrogen peroxide present in a mixture of that substance and potassium persulphate solution is not given under ordinary conditions by titration with potassium permanganate, the values obtained being always too low.

It is found that the proportion of permanganate required to decompose the hydrogen peroxide is subject to the following variations: (1) it increases with the speed of titration, (2) it varies inversely with the the concentration of the persulphate and the volume of the titrated solution, (3) it increases and finally reaches the theoretical amount when the concentration of the sulphuric acid is increased.

A fairly accurate estimation may therefore be obtained if the time of titration is short and the volume titrated is small, whilst the concentration of the sulphuric acid is fairly great.

57. "**A comparison of the products of the hydrolysis of potato starch with those obtained from cereal starches.**" **By James O'Sullivan.**

In this investigation, it was established by six series of hydrolytic experiments on potato, Lintner's, malt, barley, maize, and rice starches, with both malt-extract and diastase, that the products of the hydrolysis of potato starch, as regards the percentages of maltose and dextrin, bear no quantitative relationship to those yielded by the other starches, and that therefore the products of the hydrolysis of the other starches could not be inferred from the hydrolysis of potato starch.

March 23rd, 1904. Annual General Meeting. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Dr. G. Barger and Dr. S. B. Schryver were appointed scrutators, and the ballot was opened for the election of Officers and Council for the ensuing year. The President then presented the following Report on the state of the Society during the past twelve months:

Report of the Council.

The Council are in the fortunate position of being able to report that the Society continues to increase and flourish. At the date of the Annual General Meeting last year, the number of Fellows was 2,631 *; since that date, 170 Fellows have been elected and three reinstated, making a gross total of 2,804. Of these, 23 have been removed for non-payment of subscriptions, and the elections of 2 have become void, 28 have resigned, and 17 have died, leaving a net total of 2,734 Fellows on our list.

The names of the Fellows who have died are :

H. G. Adshead.	T. H. Dodd.	C. James.
J. O. Alexander.	T. W. Fletcher.	T. A. Lawson.
A. E. Barrows.	W. Francis.	J. Mactear.
Baron de Bush.	H. B. Fulton.	J. Reddrop.
Samuel Clift.	A. G. Hendry.	G. H. Robertson.
W. H. Corfield.	T. Isherwood.	

The following Fellows have withdrawn :

W. H. Barlow.	W. Grafton.	W. Round.
W. M. Brothers.	A. Hill.	W. J. C. Scrutton.
R. J. Brown.	T. Lemmey.	G. A. Shaw.
A. Collenette.	W. Lewins.	E. A. Smith.
W. Diamond.	H. Macan.	G. C. Thomson.
J. R. Don.	A. M. Martin.	A. L. Thornton.
D. Ferrier.	J. A. Mathews.	G. A. Waterhouse.
A. E. Garrod.	J. Morison.	W. J. Williams.
W. Goodall.	A. A. Ramsay.	A. W. Winterton.
	J. Robson.	

As in future Reports the accounts and other statistics of the Society will be given for the calendar year, the following data for the year 1903 may be of interest for purposes of comparison. The number of Fellows on January 1st, 1903, was 2,607, and during the year 173 Fellows have been elected and 5 reinstated by the Council, making a gross total of 2,785. Of these, the Society has lost 16 by death, 46 from resignations, and 23 by removal for non-payment of subscriptions, giving the number of Fellows in the Society on December 31st, 1903, as 2,700.

* Last year this number was incorrectly stated to be 2471 (*Proc.*, 1903, **19**, 81 ; *Trans.*, 1903, **83**, 629).

The Society has to lament the death of a distinguished Foreign Fellow, Professor Wladimir Markownikoff, on February 11th, 1904.

The small number of Fellows elected in the early days of the Society has been further reduced by the death of Dr. William Francis.

The scientific work of the Society during the past session gives evidence of continued activity. Since the last Annual General Meeting, 163 scientific communications have been made to the Society, 107 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

During 1903, 181 scientific communications were made to the Society, 110 of which were published in the *Transactions* for that year, abstracts of all appearing in the *Proceedings* for 1903.

The volume of *Transactions* for 1903 contains 142 memoirs occupying 1,490 pages, whilst that for the preceding year contains 160 memoirs occupying 1,604 pages.

The *Journal* for 1903 contains also 3,882 abstracts which may be classified as follows:—

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	872	1650

Part II.

General and Physical Chemistry		471
Inorganic Chemistry		443
Mineralogical Chemistry		119
Physiological Chemistry..		391
Chemistry of Vegetable Physiology and Agriculture		242
Analytical Chemistry		566
	768	2232
Total in Parts I. and II.	1640	3882

In April last, Professor Emil Fischer was invited to give the Faraday Lecture in the autumn, and provisional arrangements were made for its delivery early in the present session. Much to the regret of the Council, continued ill-health has prevented Professor Fischer from fulfilling his intention, and for the present the hope of numbering him among the Faraday Lecturers has had to be abandoned. The Council are glad to be able to announce that Professor Ostwald will deliver the Faraday Lecture on Tuesday,

April 19th, in the Lecture Theatre of the Royal Institution, kindly lent by the Managers for the occasion.

The Centenary of the Enunciation of the Atomic Theory by Dalton was celebrated by the Literary and Philosophical Society of Manchester in May last, and in company with Sir Henry Roscoe, Professor Thorpe, and Professor Frankland, Vice-Presidents, Dr. Scott, Secretary, and Sir William Ramsay, Foreign Secretary, the President attended the meeting, and presented an address in the name of the Chemical Society.

The triennial award of the Longstaff Medal to the Fellow of the Society who, in the opinion of the Council, has done the most to promote chemical science by research in the interval since the last presentation, was made, on the recommendation of the Research Fund Committee, to Professor W. J. Pope, F.R.S., for his researches on the stereochemistry of compounds of elements other than carbon.

The Fifth International Congress of Applied Chemistry was held in Berlin in June last, and the President attended as the representative of the Society. An invitation to the Congress to hold its next meeting in London, given by the President of the Society of Chemical Industry, was supported by the President, but on a vote being taken Rome was chosen as the place of the meeting in 1905.

The Council welcomed the opportunity of sending a letter of congratulation to their distinguished Foreign Fellow, Professor Mendeléeff, on the occasion of his seventieth birthday, which occurred on February 9th last.

The increase in the use of the Library mentioned in last year's report has been maintained, as 975 books were borrowed from the Library, as against 925 during the previous year. The additions to the Library comprise 115 books, of which 49 were presented, 268 volumes of periodicals, and 48 pamphlets; as against 84 books, 338 volumes of periodicals, and 23 pamphlets last year. The corresponding numbers for the year ending December 31st, 1903, are 991 books borrowed, the additions to the Library being 126 books, of which 51 were presented, 271 volumes of periodicals, and 43 pamphlets.

The changes proposed in last year's report with regard to the Library have now been carried out, and cases have been erected in one of the rooms in the basement for the storage of the less used books. These cases will accommodate about 3,500 volumes, and so provide room for the growth of the Library for about seven years. An equal number of cases can be added at any future period without cost beyond that of the cases themselves.

Mr. F. W. Clifford was appointed Librarian on July 1st.

The Council regret to have to record the death, on May 10th, of Mr. Josiah Hall, who for twenty-five years had been Collector to the

Society, and who retired in 1895 with a pension of £130 a year. It was decided to grant to Mrs. Hall, his widow, an annuity of £30.

The Society has been the fortunate recipient of two handsome busts in bronze of distinguished chemists, that of Liebig (a copy of the one in Munich) having been presented by Dr. Messel, and that of Dalton, which has been modelled from all available sources by Miss Levick, by Professor Thorpe. Two interesting photographs of portraits have also been received, one of Roger Bacon, presented by Mr. Oscar Guttmann, and one of Dr. Wm. Prout, F.R.S., from his son, the Rev. T. J. Prout.

At an Extraordinary General Meeting of the Society held on July 2nd, the proposal of the Council to alter Bye-Law I. so that the annual publications of the Society should not be sent to Fellows who are in arrear with their subscriptions was unanimously approved. To give effect to this change in the Bye-Law, the *Journal* is now issued to Fellows on the last day instead of the first day of the month. An extra number of the *Transactions* was issued on December 31st to provide for the publication of papers which would have appeared on January 1st, 1904, under the old arrangement, and now that the change has been made the net result is that Fellows receive the monthly parts of the *Journal* a day earlier than heretofore.

The first part (Authors' Index) of the Collective Index for the decade 1893—1902, promised provisionally for 1904, was issued in January to those Fellows who had made application for it in accordance with the printed notices circulated with the monthly parts of the *Journal* since last July, and it is hoped that the subject index for the same period may be ready before the end of next year. The rapid publication of the Authors' Index is due to the untiring energy and devotion of the Indexer, Mrs. Dougal, and has in no way interfered with the issue of the Annual Index at the end of February, which has been customary since she undertook the work involved in its preparation.

The Second Report of the Joint International Committee on Atomic Weights, which now includes Professor Moissan as the representative of France, with its revised table of atomic weights, has been issued to Fellows both in the *Proceedings* and in the *Journal*.

The Council resolved that the rooms of the Society should be closed not later than 10.30 p.m. on those evenings on which meetings are held, and, as very few Fellows were found to use the Library on Saturday afternoons, it was further resolved that it should be closed at 2 p.m. on Saturdays from the beginning of the present year.

Grants amounting in all to £232 have been made during the year from the Research Fund, of which amount £15 has been returned.

The Council desires to record its deep sense of obligation to Dr. Horace T. Brown for the ability and patience with which he has discharged the duties of Treasurer during the past year. Finding on taking office that a complete reorganisation of the method of collecting the contributions of Fellows and of keeping the Accounts of the Society was immediately necessary, he did not shrink from the immense labour involved in establishing a new system and getting it into operation. The nature of the changes which have been made is explained below, and it is obvious that great sacrifices of time and of personal effort were involved in the process. It is, therefore, with the utmost regret that the Council has received from Dr. Brown an intimation that his engagements no longer permit him to retain office.

In March last it was found that certain subscriptions and admission fees of Fellows which had apparently been paid had not been entered in the Books of the Society. An examination of the Books was made by a firm of Chartered Accountants, and on April 22nd, the late Assistant Secretary, who at that time was acting as Librarian and Curator, was dismissed.

The Accountants subsequently reported that an investigation of the Society's Books, carried back to March, 1895, showed that there was an apparent deficiency amounting to £2306.

The late Assistant Secretary, whilst not admitting the accuracy of the amount of the deficiency, has, up to the present, repaid to the Society sums amounting to £250.

Hitherto, it has been customary for the Treasurer to close the Books of the Society a few days before the Annual General Meeting, and to make up the Accounts to a date as near to that of the Annual Meeting as possible. This arrangement has given rise to considerable inconvenience, owing in the first place to the short time allowed to complete the financial statements, and secondly to the impossibility of conforming strictly to that portion of Bye-Law VIII, which requires the Auditors to report to the Council at least one week before the Annual General Meeting. In future, therefore, the Treasurer will present his Accounts at the Annual Meeting made up to December 31st, instead of to some indeterminate day near the end of March, and these Accounts will be drawn up in a somewhat different form from that previously adopted. A statement of the financial condition of the Society made up for the year ending December 31st last in this modified form accompanies this Report, including a Revenue and Expenditure Account and Balance Sheet, but the Treasurer has considered it advisable on this occasion to include for purposes of comparison another statement made out on exactly the old lines up to March 12th, and it is to this latter statement, which is comparable with the one of last year, that the following remarks apply.

The total income of the Society, from March 22nd, 1903, to March 12th 1904, was £7276 16*s.* 5*d.*, whilst the expenditure for the same period was £6060 17*s.* 4*d.*, showing an excess of income over expenditure of £1215 19*s.* 1*d.*, against a surplus last year of £817 7*s.* 1*d.* The comparison, however, is not a fair one, unless we adjust the figures in the respective years for the arrears of contributions in each case.

Owing to the alteration in July last of Bye-Law I, by which Fellows who are in arrear with their subscriptions do not receive the publications of the Society, the annual contributions, which become due in January, have been paid up more punctually this year than usual. On March 22nd, 1903, the arrears amounted to £2316, whilst on March 12th this year they were £2008, a difference in favour of this year of £308. When this adjustment is made, the surplus of this year becomes £907 19*s.* 1*d.* against £817 7*s.* 1*d.* last year, a result which may be regarded as highly satisfactory when we take into consideration certain large items of extraordinary expenditure which have been incurred this year, and which will be alluded to later.

The total amount received this year for Admission Fees, Life Compositions, and Subscriptions is £5809 against £4776 last year, a difference in favour of this year of £1033. This, however, includes £250 received on Account of Arrears of Subscriptions from the late Assistant Secretary, and, as already stated, the subscriptions this year are paid up more closely by £308. With these adjustments, the increased income this year from contributions of Fellows is £475, about half of which is due to the unusually large number of Life Composition Fees.

The sale of the Society's publications, and the proceeds of the advertisements in the Journal have brought in £40 9*s.* 4*d.* more than last year.

With regard to investments, the Treasurer has to report that since the last General Meeting he has, with the authority of the Council, purchased on behalf on the Society £1500 of Transvaal 3 per cent. Guaranteed Stock. The investments on the General Account now stand at £18,909 0*s.* 5*d.*, whilst those of the Research Fund Account are valued at £6659 5*s.* 5*d.*

The total expenditure this year shows the large increase of £665 19*s.* 4*d.*, which is due to certain large items of an exceptional nature.

The balance of the cost of the first volume of the Decennial Index, 1893—1902, amounting to £386 9*s.* 7*d.*, is chargeable against this year's revenue, being an increase of £254 5*s.* 3*d.* The completion of the Library Catalogue was announced in the Report of last year, but the main cost of £156 16*s.* 0*d.* has been borne by the present accounts.

The additional accommodation for books referred to in an earlier part of this Report has been provided at a cost of £128 2*s.* 4*d.* Two other large items of expenditure of an exceptional nature amounting to £228 1*s.* 6*d.* are included under Accountants' and Legal charges, and are mainly attributable to the special investigation of the Society's Accounts to 1895, to which reference has already been made above.

It is satisfactory to notice that the expenses incidental to the publication of the *Journal* show a decrease this year of about £100.

The system of keeping the Treasurer's accounts has undergone revision during the past year, the old system having been found insufficient for the present needs of the Society.

At the request of the Council, Messrs. W. B. Keen and Co., Chartered Accountants, have opened up a new set of books, and have also undertaken to give the Treasurer a quarterly audit, and to assist in the preparation of the accounts for the Annual Statement.

This arrangement, which guarantees skilled professional assistance and a thorough checking of the accounts at frequent intervals, has now been in operation for some time, and will not entail any additional expense to the Society, as the appointment of a Treasurer's Assistant is thereby rendered unnecessary.

Arrangements have been made with Messrs. Coutts and Co., the Society's Bankers, by which in future they will receive the contributions of Fellows direct.

Professor H. B. Dixon moved the adoption of the report, which was seconded by Mr. E. W. Voelcker and carried unanimously.

Dr. Scott proposed, and Dr. Philip seconded, a vote of thanks to the Auditors, which was acknowleged by Dr. Moody.

The President then delivered his address, which was devoted chiefly to a review of the scientific history of the Society since its foundation in 1841. The early volumes of the Memoirs of the Society contain papers by many eminent foreign chemists, such as that on "The Atomic Weight of Carbon," by Professors Redtenbacher and Liebig, and the memoir on "The Radical of the Cacodyl Series," by Professor Bunsen. These and others, such as Frankland's paper on "The Isolation of the Organic Radicals," indicate the general nature of the problems which occupied chemists in the early days of the Society. The *Quarterly Journal*, which, in 1849, succeeded the three volumes of Memoirs, contain many contributions by Hofmann, Williamson, Frankland, Kolbe, and Odling, but as it was the custom in those days for authors to send all their more serious work to the Royal Society, the *Journal of the Chemical Society* does not provide a continuous picture of the results of chemical investigation in this country. In 1862, the *Quarterly*

Journal was replaced by a monthly issue, and in 1863 a new series was commenced.

At that period, language and formulæ were alike governed by the then predominant theory of types. Modern views of constitution based on clearer ideas of valency were not definitely exhibited in the *Journal* till 1865, when Dr. Crum Brown's paper appeared on "The Theory of Isomeric Compounds." The change could, however, be accomplished only after agreement had been arrived at in reference to atomic weights. Stereochemical ideas, inaugurated in 1875 by Le Bel and van't Hoff, have reached their logical conclusion in the work of Pope.

Other subjects traced through the successive volumes of the *Journal* are the spectroscope, the periodic scheme of classification, molecular weights, and the application of Avogadro's law. The paucity of systematic research in the United Kingdom during so many years was referred to, and some of the causes which led to the publication of so few papers by the Society, and the rapid development of activity during the last twenty years.

The address concluded with a suggestion for the publication by the Society of annual reports on the progress of chemistry in its several more important divisions.

Professor EMERSON REYNOLDS proposed a vote of thanks to the President, coupled with a request that he would allow his address to be printed in the *Transactions*.

Mr. DAVID HOWARD seconded the motion, which was carried by acclamation and acknowleged by the PRESIDENT.

Professor DIVERS proposed a vote of thanks to the Treasurer, Secretaries, and Council. This was seconded by Mr. SPILLER and unanimously adopted. Dr. SCOTT responded.

The Scrutators presented their report to the President, who declared the following to have been duly elected as Officers and Council for the ensuing year:

President: W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: Horace T. Brown, LL.D., F.R.S.; Harold B. Dixon, M.A., F.R.S.; Wyndham R. Dunstan, M.A., F.R.S.; P. F. Frankland, LL.D., F.R.S.; David Howard; Raphael Meldola, F.R.S.

Secretaries: W. P. Wynne, D.Sc., F.R.S.; M. O. Forster, D.Sc., Ph.D.

Foreign Secretary: Sir W. Ramsay, K.C.B., LL.D., F.R.S.

Treasurer: Alexander Scott, M.A., D.Sc., F.R.S.

Other Members of Council: Augustus E. Dixon, M.D.; J. J. Dobbie, M.A., D.Sc.; Bernard Dyer, D.Sc.; Alfred D. Hall, M.A.; A. Harden, D.Sc., Ph.D.; J. T. Hewitt, M.A., D.Sc.; C. A. Kohn, Ph.D., B.Sc.; A. Lapworth, D.Sc.; J. E. Marsh, M.A.; E. J. Mills, D.Sc., F.R.S.; S. Ruhemann, M.A., Ph.D.; J. M. Thomson, LL.D., F.R.S.

ERRATA.

PROC., 1904, Vol. 20.

P. 51, line 22, *for* "$CH\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle C\!=\!\!=\!\!=\!C\!-\!CH_2\rangle CH\cdot CO_2H$," *read* "$CO_2H\cdot CH\langle^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}\rangle C\!=\!\!=\!\!=\!C\!-\!CH_2\rangle CH\cdot CO_2H$."

P. 51, line 2*, for "*α-hydroxyhexahydroterephthalic acid*," read "cis-*α-hydroxyhexahydroterephthalic acid*."

* From bottom.

THE FARADAY LECTURE.

The Faraday Lecture will be delivered by Professor W. Ostwald on **Tuesday, April 19th, 1904, at 8.30 p.m.**

Professor Ostwald will lecture in English, the subject of his discourse being "Elements and Compounds."

The Lecture will be delivered, by the kind permission of the Managers, in the **Theatre of the Royal Institution, 21, Albemarle Street, W.**

Admission will be by ticket only. Each Fellow of the Society is entitled to two tickets, which may be obtained on application to the Assistant Secretary, Chemical Society, Burlington House, W.

At the next Ordinary Meeting, on **Wednesday, April 20th, 1904, at 5.30 p.m.**, the following papers will be communicated.

"The vapour density of hydrazine hydrate." By Alexander Scott.

"The combining volumes of carbon monoxide and oxygen." By Alexander Scott.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C. AND BUNGAY, SUFFOLK.

Issued 30/4/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 279.

April 19th, 1904. Extra Meeting, Professor W. A. TILDEN, D.Sc. F.R.S., President, in the Chair. This meeting was held in the Theatre of the Royal Institution, by kind permission of the Managers.

The PRESIDENT, in opening the proceedings, said:—So many years have elapsed since we enjoyed the delivery of a Faraday Lecture that perhaps a few words of introduction may not be regarded as inopportune. Faraday died in 1867, and immediately after his decease the Council of the Chemical Society met together and determined that, if possible, they would do something permanently to do honour to his memory; and the result was that, after considerable deliberation, they decided to establish this system of lectures. The first of the course was given in 1869 by Dumas, only two years after Faraday's death. Dumas was succeeded by Cannizzaro, Hofmann, Wurtz, Helmholtz, Mendeléeff and Lord Rayleigh. You will see, therefore, that the most eminent men of science living at the time were ready to accept the invitation to undertake the office of Faraday Lecturer. Owing to accidental circumstances it is, however, a rather long period—some 23 years—since we heard the voice of a Faraday Lecturer. Thanks to the kindness of the Members and the Managers of the Royal Institution, the lectures have all, hitherto, been given within this place, the walls of which for so many years echoed to the voice of Faraday, and which were the witness of his teaching and his triumphs. The Council of the Chemical Society were naturally

anxious on the present occasion, as on all previous occasions, to find a man who might safely be regarded as qualified by his own researches and by his own contributions to science, worthily to fill the office of Faraday Lecturer; and they are satisfied that they have found such a man among their own Honorary Members. Professor Ostwald is a man who is not only honoured in the country of his adoption, but is famous throughout the world as the apostle of the modern doctrines concerning chemical affinity and the mechanism of chemical action. I will not, however, occupy any further time, but ask Professor Ostwald to be good enough to give us his lecture.

Professor OSTWALD then delivered the Faraday Lecture, of which the following account is an abstract.

"Elements and compounds."

The most general concept underlying all chemical theory is that of a *phase* created by Willard Gibbs. A phase is a physical homogeneous body, which may be either chemically homogeneous or composed of any number of substances. Every single phase has two degrees of freedom, irrespective of its chemical simplicity or complexity. A difference arises only if a second phase is formed. When that happens, we have two different cases: either the properties of the remaining part of the first phase change during the transformation into a new phase, or they remain constant. Phases of the first order we call *solutions*; of the second, *hylotropic bodies*.

By forming a new phase of a solution, we get two portions possessing different properties. On separating these parts, and on repeating the separation into two phases, every solution finally splits up into a finite number of hylotropic bodies.

Generally, a hylotropic body behaves as such only within certain limits of temperature and pressure. Beyond these limits of stability, it assumes the properties of a solution, and can therefore be split up again into a finite number of other hylotropic bodies. These we call *simpler* bodies than the former. At last it becomes impossible to change the hylotropic body into a solution, because it is not found practicable to reach its limit of stability. *Substances which can form only hylotropic phases we call elements.*

With hylotropic substances, we can again distinguish two cases. (1) Either the hylotropic body can exist as such only at one definite temperature and pressure, and by changing these conditions the body is transformed into a solution. This is the case with solutions of constant boiling point (for example, the solution of acids investigated by Sir Henry Roscoe) or with cryohydrates, &c. (2) Or there is a finite range of temperatures and pressures within which the phase invariably

behaves as a hylotropic body; in this case, we have a *substance* proper. A substance or chemical individual is therefore the limiting case of hylotropic solutions, and is defined experimentally by its not changing its properties if the phase is partially transformed into another, for example, by distillation or crystallisation. This is indeed the way in which pure substances are defined and identified practically.

The constancy of properties is causally connected with constancy of composition; that is, if it is possible to produce a substance proper from other substances or hylotropic bodies, the ratio of the weights of the component parts must have a certain value in order that this peculiar body of constant properties may be formed. This is the *law of constant proportions.*

In forming such peculiar bodies, elements and compounds behave alike, and there is, therefore, in every case a certain definite relation between a substance and its components, the last being compounds or elements. A compound substance can therefore be split up into, or regenerated from, elements only in one definite manner. If we form a ternary compound ABC of the elements A, B, and C, we get the same substance by forming first AB and uniting it with C, or by first preparing AC and combining this with B, or, lastly, in forming the compound ABC directly from the elements.

By combining A with B, we get a certain ratio of weights between the two elements, and also a ratio for C by combining it with AB to form ABC. Now, as the composition of ABC is independent of the manner of formation, the composition of a substance AC is not more arbitrary, but is already defined by the composition of ABC, for it must contain A and C in the same ratio as in ABC. In the same way, the composition of a substance BC is defined in such a manner that the elements A, B, C, can combine only in definite ratios, regulated by the combining weight of each element for the compound ABC. This is the *law of combining weights*, generally spoken of as the law of atomic weights.

From this law, the *law of multiple proportions* can be deduced easily by applying the same considerations to the case of two elements forming more than one compound.

All the stoichiometrical laws, which have hitherto been deduced and explained only by the atomic hypothesis, prove to be direct consequences of the purely empirical definition of the concept of a substance proper or a chemical individual, and the atomic hypothesis is rendered superfluous for the purpose of this deduction.

According to the energetic theory of the elements, these bodies are explained as being distinguishing points of maximum stability relative to all adjacent conceivable substances. If we assume that the two characteristics are sufficient to determine the nature of a substance, and if we

put these characteristics in plane co-ordinates horizontally and erect vertical lines in every point of the plane to express the free energy of the corresponding substances, we get a continuous surface like the stalactitic ceiling of a cavern, the end of each stalactite representing an element. A drop of water hanging on the ceiling represents by its flow the possible changes between the elements. To bring the drop from one stalactite to another, it must be raised above the pass between the two stalactites. This requires a certain concentration of free energy, and the practical impossibility of changing one element into another is due to the practical impossibility of bringing about the required concentration of energy. Now, with radium and other unstable elements, energy is not a relative minimum compared with the adjacent possible substances, but only a change in the slope of the surface which represents it. The drop of water can flow of its own accord from the point of the element, and will only lessen its speed on passing through this point. As the drop arrives finally at the end of the stalactite of helium, which is very low indeed (because helium cannot even form compounds), the enormous development of energy connected with this transmutation is explained at once. From the general law, that the most stable point of a changing system is not reached directly, but only through all the possible stages of unstable forms of the system, the intermediate formation of new and transitory substances and of new and transitory forms of energy is also explained, again without any application of hypothetical atomic concepts.

In presenting the Faraday Medal to Professor Ostwald at the conclusion of the Lecture, the PRESIDENT said:—It is now my pleasant duty, Professor Ostwald, in the name of the Society, to offer for your acceptance this medal, which bears the image of Faraday, and which has been struck in commemoration of this occasion.

Professor DEWAR: You, Sir, have placed upon me the very onerous duty of expressing the grateful thanks of the members of the Chemical Society of London to Professor Ostwald for the magnificent way in which he has discharged the duties of Faraday Lecturer, and the honour he has done us in accepting that office. You, Sir, have pointed to the great galaxy of talent with which he must be associated for all time, in referring to the great names of those who in the past have occupied the position. Now I am quite sure that every chemist in England, when he heard that Professor Ostwald was selected for this office, had a hopeful anticipation that he would rival his compeers. You, fellow-workers, have listened to the mode in which he has passed through this great ordeal, and I am sure that you will all acknowledge the splendid achievement of his success. I think, Sir, we might even go farther and say that no greater enjoyment could have been

given to Faraday, if we could imagine his being present here this evening, than to have received Professor Ostwald; for his life and spirit has been the spirit of Faraday, and that has led to his great position as a worker and to the establishment of his great school of physical chemistry. We may rest assured that the man who has done so much to develop the electro-chemical theory and the theory of dielectrics which originated in this place would have been a delight to Faraday. But I think we ought to go farther, and say that, while in the past we have had the eulogy of Faraday, while we have had admirable summations of his character and work by his admirers, we have never before had such an original pronouncement. We have received for the first time an original contribution that is likely to give us matter for thought for many a day to come. I think that the selection of the subject of the address in itself would have delighted Faraday, who again and again returned to the discussion of the nature of the elementary bodies. I was curious to ascertain what was the last pronouncement which Faraday gave in this room with regard to the elements; and I found it in a Friday evening lecture in the year 1836 (subsequent to his discovery of definite electrolysis), entitled "The Nature of the Chemical Elements." The last sentence is most interesting. He says: "Thus, either present elements are the true elements, or else there is the probability before us of obtaining *some more high and general power* of Nature even than electricity, which at the same time might reveal to us an entirely *new* grade of the elements of matter now hidden from our view and almost from our suspicion." That was Faraday's view sixty-eight years ago, given in this very room and at that very table. It is quite clear that at that time he would have been staggered if he could have known that a substance with which he was familiar, in the form of an oxide, and which had been taken for an element—namely, the substance uranium—contained within itself that very spontaneous change into the "new grade of the elements" which Professor Ostwald has so admirably illustrated.

The Professor's stalactite cavern is a cavern of great mystery, and is indeed one in which we may require a great deal more light before we can get acclimatised to the surroundings. But that does not withdraw one iota from the originality and the brilliancy of the lecture which we have had to-night, and I ask you, Sir, to allow me, on behalf of the Chemical Society and the world of English science to propose a vote of thanks to Professor Ostwald for the noble way in which he has discharged his duty.

Dr. THORPE: Ladies and Gentlemen, I rise at the bidding of the President to discharge what I feel to be a very honourable duty, namely, to join with Professor Dewar in giving expression to the

gratitude which the Fellows of the Chemical Society feel to Professor Ostwald for the Faraday Lecture which he has given to night. The President has told you that one characteristic of the Faraday Lectures is that they are given in this hall, a hall which, of course, is hallowed by the associations of Faraday. Now, if anybody will cast a retrospective glance over the Faraday Lectures, they will find that there is one fundamental conception common to them all. However different they may seem at first sight, they are all concerned fundamentally with the idea of the essential nature of chemical action and the essential nature of elements and compounds. Now, if those two things be the characteristics, namely, that the Faraday Lectures are given here and that they are all concerned with that fundamental idea—Professor Dewar would seem to have proved that Faraday himself was the first Faraday Lecturer. I venture, however, to point out that in reality the first Faraday Lecturer was John Dalton, for it was from that very place which Professor Ostwald has just occupied that John Dalton, in the winter of 1809, developed before such an audience as we have here to-night the conceptions which are immortally associated with his name. It was to an audience which, I suppose, may have comprised men like Young, Wollaston, Sir Joseph Banks, and Humphry Davy himself, that John Dalton, in his characteristic, simple, straightforward, lucid way, laid before a Royal Institution audience the first "Faraday Lecture." I have the greatest possible pleasure, Ladies and Gentlemen, in echoing the sentiment which has been so eloquently expressed by my colleague, Professor Dewar, in asking you to tender to Professor Ostwald our most grateful thanks for the intellectual treat which he has afforded us to-night.

Lord RAYLEIGH: I wish the President had seen fit to call upon someone more conversant than I am with the course of chemical thought and speculation to speak to this resolution. I feel that I follow only at a distance, and, although anyone who has heard Professor Ostwald to-night could not fail to take up some valuable ideas, I think most of us must feel that a good deal of thought is required before we should be in a position to do justice to what has been laid before us. We certainly live in a very interesting time. Twenty or thirty years ago an idea was not uncommon, I think, that we understood tolerably well the general course of Nature, and that all that was wanted was to fill up certain details where difficulties of one sort or another had interfered with our acquiring adequate knowledge. I believe that the feeling at the present day among scientific men, and, perhaps, especially among those scientific men who have taken the largest part in recent work, would be a very much more modest one, and that most of us are quite prepared to recognise that we must face

possible revolutions in those ideas which in many cases we have hitherto regarded as most firmly established. It is in connection with such thoughts that I think we recognise the value of what we have heard to-night, and I, certainly, for one shall look forward to studying in detail what has been set before us. I desire most heartily to support the resolution which has been moved and seconded.

The motion was then put by the PRESIDENT and carried with acclamation.

Professor OSTWALD: Mr. President, Ladies and Gentlemen:—Now that my task of reading from print is at an end, I feel a difficulty in going some steps farther into unknown English periods. I cannot bring sufficient English together to express my deep feeling of thanks for the honour which has been shown to me in the way in which you have received my ideas. I feel that I was not mistaken when I tried to bring this work into your own land in the face of one of the best things ever done in science, I mean the atomic hypothesis. My purpose was to show that the atomic hypothesis is no longer necessary to explain the stoichiometrical laws. But the views arrived at, and the progress attained by the use of the atomic hypothesis cannot be destroyed. They have directed the discoveries of chemistry for a whole century, and if any hypothesis can do good, this one has done so. Therefore I do not think this hypothesis need be interred yet, and when the time comes it should be interred with the greatest honour.

Wednesday, April 20th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. G. E. P. Broderick, H. W. Gadd, and T. S. Price were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Albert Ernest Bellars, B.A., Magdalene College, Cambridge.
Herbert Frank Brand, M.A., B.Sc., 13, Clifton Road, Brockley, S.E.
Thomas Alfred Gerard, 122, Foxhall Road, Nottingham.
James Gray Gilchrist, M.A., 48, Ovington Street, Chelsea, S.W.
John Haslam Johnston, M.Sc., Public Offices, Hampton, Middlesex.
Alfred Pell, 44, Cumballa Hill, Bombay.
David John Pinkerton, 17, Orbiston Street, Motherwell.
Percy Richard Sanders, West Cliffe, Seaford, Sussex.
James Alfred Wilkinson, M.A., Transvaal Technical Institute, Johannesburg.

The PRESIDENT stated that the Council had resolved to present the following address to Sir Henry E. Roscoe on the occasion of the celebration of the Jubilee of his Doctorate, on Friday, April 22nd, 1904, fifty years having elapsed since he graduated as Doctor of Philosophy at Heidelberg on March 15th, 1854.

To SIR HENRY ENFIELD ROSCOE, Ph.D., LL.D., D.Sc., F.R.S.

The Officers and Council of the Chemical Society desire to join the rest of your Scientific friends in offering hearty congratulations on the attainment of the Jubilee of your Doctorate.

More than forty years ago, when there were few schools of scientific chemistry in this Country, by your teaching and example you not only revived the fortunes of the College in Manchester to which, during so many years, you were attached, but assisted in arousing a new spirit in the other teaching institutions of Great Britain.

They recall with pleasure and gratitude the services you rendered to the Society when, many years later, you became its President and by your genial personal influence assisted so materially in promoting its activity and usefulness.

They wish you many years of health to enjoy the further developments of Scientific Research and the further applications of Scientific Knowledge to useful purposes, to which the greater part of your life has been devoted.

(Signed.) WILLIAM A. TILDEN, *President.*
ALEXANDER SCOTT, *Treasurer.*
W. PALMER WYNNE, M. O. FORSTER } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

Of the following papers, those marked * were read:

***58. "The vapour density of hydrazine hydrate." By Alexander Scott.**

The determinations by Curtius and Schulz (*J. pr. Chem.*, 1890, [ii], 42, 529) of the vapour density of hydrazine hydrate at various temperatures are interpreted by them to indicate something quite anomalous in the behaviour of this substance in the state of vapour. They state that at 100° the vapour density determined by Hofmann's method corresponds with the molecule N_2H_4,H_2O, and at 170° at atmospheric pressure to $N_2H_4 + H_2O$, but that at higher temperatures larger molecules are largely regenerated and that at very high temperatures the vapour density indicates a molecular weight double that

of the original. The author finds that at 98·8° the vapour density is 15·8 instead of 25 as required by N_2H_6O, at 138° the dissociation into $N_2H_4 + H_2O$ is complete, and that at higher temperatures, a certain amount of decomposition into nitrogen, ammonia, and water occurs. If the vapour densities by V. Meyer's method were determined in an atmosphere of air, oxidation of the hydrazine would ensue, leading to completely erroneous results, even at comparatively low temperatures, but by using nitrogen this source of error is avoided.

***59. "The combining volumes of carbon monoxide and oxygen." By Alexander Scott.**

The ratio by volume in which carbon monoxide combines with oxygen has been determined by means of the same apparatus as was employed by the author in estimating the composition by volume of water (*Phil. Trans.*, 1893, **184**, A, 543). The results of the author's experiments indicate that the molecular concentration of carbon monoxide is slightly greater than that of oxygen, the combining volumes being CO : O : : 1·9985 : 1 with carbon monoxide from calcium oxalate and 1·9994 : 1 with that from formic acid. Applying a correction for this to Lord Rayleigh's recently published value for the density of carbon monoxide so as to obtain its molecular weight, we obtain CO = 27·99 and C = 11·99.

***60. "A revision of the atomic weight of rubidium." By Ebenezer Henry Archibald.**

Commercial rubidium iodide was converted into the dichloriodide ($RbCl_2I$) and fractionally crystallised many times until the salt had become spectroscopically free from potassium, when the product was divided into four portions, which each received a different number of additional fractionations. In order to remove the cæsium, the rubidium was either repeatedly precipitated as chloride with hydrogen chloride or the hydrogen tartrate was fractionally crystallised. After being fused and bottled by means of Richards' bottling apparatus (*Proc. Amer. Acad.*, 1896, **32**, 55), four samples of rubidium chloride purified by these processes were analysed by precipitating the chlorine with silver nitrate, estimating the amount of silver required for complete precipitation, and also the amount of silver chloride produced. The mean values of the atomic weight of rubidium obtained from 14 analyses were 85·490 and 85·484 from the ratios AgCl : RbCl and Ag : RbCl respectively (O = 16·0).

Analyses of rubidium bromide led to the value 85·483, obtained from either of the ratios AgBr : RbBr or Ag : RbBr.

***61. "Experiments on the synthesis of the terpenes. Part I. Synthesis of inactive terpineol, dipentene, and terpin hydrate." By William Henry Perkin, jun.**

It was recently shown (*Trans.*, 1904, 85, 416) that pentane-$a\gamma\epsilon$-tricarboxylic acid, $CO_2H\cdot CH(CH_2\cdot CH_2\cdot CO_2H)_2$, when digested with acetic anhydride and subsequently distilled, is converted into δ-ketohexahydrobenzoic acid. The ester of this acid reacts readily with magnesium methyl iodide, yielding, among other products, *cis*-δ-hydroxyhexahydro-*p*-toluic acid (compare Stephan and Helle, *Ber.*, 1902, 35, 2153):

$$CO\begin{<}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CO_2Et \longrightarrow CMe(OH)\begin{<}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CO_2H.$$

This acid melts at 153°, and on distillation is readily converted into its lactone, a solid, crystalline substance, which melts at 70° and distils at about 185° under 150 mm. pressure.

When the hydroxy-acid (or its lactone) is left in contact with fuming aqueous hydrobromic acid, it is converted into δ-bromohexahydro-*p*-toluic acid, a crystalline substance which melts at 126°, and which, when digested with pyridine or with sodium carbonate, yields Δ^3-tetrahydro-*p*-toluic acid (m. p. 99°):

$$CMe\begin{<}CH{-}CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CO_2H.$$

If the ester of this acid is mixed with an excess of an ethereal solution of magnesium methyl iodide, and the product, after remaining for 24 hours, is treated with dilute hydrochloric acid, a colourless oil is obtained, which distils at 133° under 60 mm. pressure and has a pronounced odour of lilac. That the above reaction takes place according to the scheme:

$$CMe\begin{<}CH{-}CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CO_2Et \longrightarrow CMe\begin{<}CH{-}CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CMe_2\cdot OH,$$

and that the oil obtained is therefore inactive *terpineol* is clearly proved by the following facts. It yielded, on analysis, numbers agreeing with the formula $C_{10}H_{18}O$, and, when digested with potassium hydrogen sulphate, was converted almost quantitatively into dipentene,

$$CMe\begin{<}CH{-}CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CMe{:}CH_2.$$

The *dipentene* thus synthesised was found to be identical in all respects with that obtained from ordinary terpineol by the same process. It distilled at 181—182°, had a characteristic odour of

lemons, and yielded, with bromine, *dipentenetetrabromide*, $C_{10}H_{16}Br_4$ (m. p. 125°), and, with hydrogen chloride, *dipentene dihydrochloride*, $C_{10}H_{16},2HCl$ (m. p. 48—50°).

Furthermore, the synthetical terpineol was slowly converted by treatment with dilute sulphuric acid into terpin hydrate,

$$C_{10}H_{18}(OH)_2,H_2O$$

(m. p. 118°), from which terpin itself,

$$CMe(OH)\begin{<}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{>}CH\cdot CMe_2\cdot OH,$$

was readily obtained by dehydration.

These experiments are being continued and extended to the study of the behaviour of ethyl γ-ketohexahydrobenzoate and other similarly constituted substances towards magnesium methyl iodide.

*62. "A lævorotatory modification of quercitol." By Frederick Belding Power and Frank Tutin.

Quercitol, $C_6H_{12}O_5$, has hitherto only been found in the fruits (acorns) of certain species of *Quercus*, in which it exists as a dextrorotatory modification. The lævorotatory modification described by the authors was obtained from the leaves of *Gymnema sylvestre* (Br.), a plant belonging to the family of *Asclepiadaceæ*, and indigenous to Banda and the Deccan Peninsula.

l-Quercitol is a colourless, crystalline substance, which, when crystallised from water, has the formula $C_6H_{12}O_5,H_2O$; it loses its molecule of water at 110°, melts at 174°, and has $[\alpha]_D$ −73·9°. The dried substance separates from ethyl alcohol in the anhydrous state. *Pentaacetyl-l-quercitol*, $C_6H_7(O\cdot C_2H_3O)_5$, crystallises from dilute alcohol in needles, melts at 124—125°, and has $[\alpha]_D$ −26·0°. *Pentabenzoyl-l-quercitol*, $C_6H_7(O\cdot C_7H_5O)_5$, separates from a mixture of alcohol, ethyl acetate, and petroleum in needles containing a molecule of alcohol, which, when heated slowly, melt at 148°; it has $[\alpha]_D$ −79·0°. On oxidising *l*-quercitol with sodium hypobromite and treating the product with phenylhydrazine, *dikstotrihydroxyhexahydrobenzenedihydrazone*, $C_6H_5(OH)_3(:N\cdot NH\cdot C_6H_5)_2$, was obtained, which separates from alcohol in yellow needles and melts at 209°. On oxidising with cold potassium permanganate solution, malonic acid was obtained, and was identified by means of its ethyl ester.

Kiliani and Schaefer (*Ber.*, 1896, **29**, 1762) have shown that *d*-quercitol is a pentahydroxyhexahydrobenzene, by the formation, on the one hand, of malonic acid, and, on the other, of a diketone, $C_6H_8O_5$. The substance isolated by the authors, designated as *l*-quercitol, is, therefore, one of the eight possible isomerides of pentahydroxyhexa-

hydrobenzene, but, until a further number of these have been isolated, it will be impossible to assign to either of the known quercitols a definite configuration.

***63. "The constituents of the essential oil of Californian laurel." By Frederick Belding Power and Frederic Herbert Lees.**

The Californian laurel, *Umbellularia Californica* (Nuttall), a handsome, evergreen tree, occurring in California and Oregon, is also known as "mountain laurel," "cajeput," "spice tree," "California olive," "California bay tree" and "pepper-wood."

The essential oil of the leaves had a pale yellow colour and an odour which was at first agreeably aromatic, but when more strongly inhaled became exceedingly irritating to the mucous membranes of the nose and eyes, producing the effects that have previously been described. The oil had a sp. gr. 0·9483 at 16°/16°, and $[\alpha]_D$ −22° in a 100 mm. tube; it was completely soluble in 1·5 parts of 70 per cent. alcohol. It was found to contain an inappreciable amount of esters and a very small quantity of a mixture of free fatty acids, including formic acid. The essential constituents of the oil were found to be: eugenol, *l*-pinene, cineol, safrole, eugenol methyl ether, veratric acid, and a new, unsaturated, cyclic ketone, *umbellulone*, $C_{10}H_{14}O$, which is a colourless liquid with a somewhat mint-like odour, having in a high degree the peculiar pungency of the original oil. It boils at 219—220° (corr.), has a sp. gr. of 0·9581 at 15°/15°, and $[\alpha]_D$ −37°. This ketone does not react normally with semicarbazide and hydroxylamine, affording with the former, *semicarbazidodihydroumbellulonesemicarbazone*, $C_{10}H_{15}{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2(CH_4ON_3)$ (m. p. 217°), and with the latter, *hydroxylaminodihydroumbelluloneoxime*,

$$C_{10}H_{15}(:NOH){\cdot}NH{\cdot}OH$$

(compare *Ber.*, 1897, **30**, 230, 251; 1900, **33**, 562, and 1903, **36**, 4377).

The relative proportions of these constituents of the oil were approximately as follows: umbellulone, 60; cineol, 20; eugenol methyl ether, 10; pinene, 6, and eugenol, 1·7 per cent. respectively, together with a very small amount of safrole.

***64. "Some derivatives of umbellulone." By Frederic Herbert Lees.**

With the view of elucidating the constitution of umbellulone, $C_{10}H_{14}O$, the new ketone isolated by Power and the author from the essential oil of Californian laurel, the following derivatives have been prepared.

Umbellulone combines directly in the cold with only 2 atomic proportions of bromine, forming *umbellulone dibromide*, $C_{10}H_{14}OBr_2$, an unstable oil. Umbellulone would therefore appear to contain only one ethylenic linking, and in consideration of this circumstance and the fact that, like the $a\beta$-unsaturated ketones generally, it behaves abnormally towards hydroxylamine and semicarbazide, one molecule of the ketone interacting with two molecules of these bases respectively (compare preceding abstract), it is regarded as an $a\beta$-unsaturated cyclic ketone containing two closed rings.

When umbellulone dibromide is heated under diminished pressure, it loses hydrogen bromide, yielding an *unsaturated bromo-ketone*, $C_{10}H_{13}OBr$ (b. p. 140—145°/20 mm.), and *dibromodihydroumbellulone*, $C_{10}H_{14}OBr_2$, which forms needles melting at 119—119·5° and having $[a]_D + 6·4°$ in chloroform. When the unsaturated bromo-ketone is reduced with zinc dust and acetic acid, a *saturated ketone*, $C_{10}H_{16}O$ (b. p. 214—217°), is produced; the *semicarbazone* of the latter $C_{10}H_{16}{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$, forms needles which melt at 171—172°.

When dibromodihydroumbellulone is reduced with zinc dust and acetic acid, it is converted into *bromodihydroumbellulone*, $C_{10}H_{15}OBr$, which forms needles melting at 58—59° and having $[a]_D - 70·1°$ in chloroform. When this bromo-derivative is reduced with sodium and alcohol, it gives *tetrahydroumbellulol*, $C_{10}H_{19}{\cdot}OH$ (b. p. 207—208°/760 mm.), which has a sp. gr. 0·9071 at 15°/15° and $[a]_D - 6·6°$.

Umbellulone is readily oxidised by cold potassium permanganate, yielding a *lactone*, $C_9H_{12}O_2$, together with several acids which have not yet been investigated.

The author wishes to reserve the further investigation of umbellulone.

65. "Ammoniacal double chromates and molybdates." By Samuel Henry Clifford Briggs.

A number of double salts of ammonium chromate belonging to a series of compounds having the general formula $M_2^{I}M^{II}(RO_4)_2,2NH_3$ have already been described (*Trans.*, 1903, **83**, 391). Other members of the same series have now been prepared, M^{I} being either NH_4 or K; M^{II} being Cu, Zn, Cd, Co, or Ni, and R indicating either Cr or Mo. The corresponding tungstates could not be obtained.

The compounds $CuCrO_4,3\frac{1}{2}NH_3,\frac{1}{2}H_2O$; $CuMoO_4,2NH_3,H_2O$; $CuWO_4,4NH_3$, and $ZnWO_4,4NH_3,3H_2O$ have been incidentally prepared during the investigation.

66. "The hexahydrated double chromates. Magnesium and nickel compounds." By Samuel Henry Clifford Briggs.

The double chromates $M_2^{I}M^{II}(CrO_4)_2,6H_2O$, in which M^{II} is magnesium or nickel and M^{I} is K, Rb or Cs, have been prepared.

The nickel compounds were obtained by adding a solution of the alkali chromate to a solution of nickel acetate, at the ordinary temperature for the rubidium and cæsium salts and at $-6°$ for the potassium compound.

The magnesium compounds crystallised out when cold concentrated solutions of their components were mixed, the preparation of the potassium salt being carried out at $-10°$.

Both the potassium compounds are very efflorescent at the ordinary temperature, whilst in the case of the series of salts in which M^{II} is the same, the stability increases with the atomic weight of the alkali metal. This variation is in the same sense as that found by Tutton (*Trans.*, 1896, **69**, 521) for the relative stabilities of the corresponding double sulphates.

67. "Hydrocellulose." By Charles Frederick Cross and Edward John Bevan.

The residues described by Stern (*Trans.*, 1904, **85**, 336) having the empirical composition of cellulose are no doubt products of hydrolysis and reversion, and are constitutionally different from the original cellulose; but they are in no case identical with those described by Girard, and therefore this investigator's exhaustive account of the actions of acids on cellulose remains unaffected by the criticisms contained in the above-mentioned paper. The statements (*loc. cit.*) as to the causes of the attendant structural changes are, moreover, improbable.

Cellulose is a chemically labile and structurally plastic aggregate, occupying an intermediate position between the two extremes, determined by the action of (*a*) alkali hydroxides, (*b*) the halogen hydracids, both in presence of water.

It is suggested that the terms hydracellulose and hydrocellulose respectively may for the present be retained to designate the two groups of derivatives obtained by the processes (*a*) and (*b*).

68. "Bornylcarbimide." By Martin Onslow Forster and Herbert Moore Attwell.

The appearance of a paper by Doht and Haager (*Monatsh.*, 1903, **24**, 844) dealing with the production of phenylcarbimide by the action of nitrous acid on phenylcarbamide leads us to record a similar observation which we have made in connection with bornylcarbamide.

Bornylcarbimide, $C_{10}H_{17}\cdot N:C:O$, prepared by adding solid sodium nitrite to bornylcarbamide nitrate suspended in water at 0°, is a colourless, crystalline substance which melts at 72°; it is very volatile, and the vapour is intensely pungent. A 2 per cent. solution in benzene has $[\alpha]_D$ +46·5°. It is hydrolysed by acids and alkalis, yielding bornylamine, whilst aniline converts it into bornylphenylcarbamide, previously obtained from bornylamine and phenylcarbimide (*Trans.*, 1898, **73**, 393).

Dibornylthiocarbamide, $S:C(NH\cdot C_{10}H_{17})_2$, obtained on heating bornylamine with carbon disulphide and alcohol until hydrogen sulphide is no longer liberated, melts at 227°.

Bornylamine bornyldithiocarbamate, $C_{10}H_{17}\cdot NH\cdot CS\cdot SH,C_{10}H_{17}\cdot NH_2$, is produced at the same time and melts at 78°.

Bornylamine thiocyanate crystallises from hot water in long, lustrous needles melting at 178°; above this temperature, it changes into dibornylthiocarbamide.

69. "Reduced silicates." By Charles Simmonds.

The substance left when lead silicates are reduced by heating in hydrogen (*Trans.*, 1903, **83**, 1449) is in general shown to be a compound which can be regarded as a combination of the metal and silica, in the same sense as the original silicate is a combination of the metallic oxide and silica. In some cases, however, a certain proportion of metallic lead is mixed with the substance: this occurs when the original silicates (for example, orthosilicates and basic silicates) contain a greater number of basic than of acidic oxides in the silicate molecule.

The reduced residues are generally more refractory than the original silicates. Treatment with the commoner acids and oxidising agents has little effect on them, but they are decomposed by hydrofluoric acid and by fusion with alkali carbonates. The term "silicites" is suggested for these reduced silicates.

Similar results were obtained with the silicates of copper, iron, nickel, and cobalt.

70. "Picryl derivatives of urethane and thiourethane." By James Codrington Crocker and Frank Harold Lowe.

The authors show that the reaction between picryl chloride, thiocyanates, and alcohols is due to the formation of the ψ-thiourethanes, PiN:C(SH)·OX, as intermediate products, which subsequently react with picryl chloride and pass into the picriminothiocarbonates, PiN:C(SPi)·OX. The results obtained with the cyanates, picryl chloride, and alcohol confirm this view. Under these conditions, the corresponding urethanes, PiNH·CO·OX, are formed, and in the case of ethyl alcohol, the picriminocarbonate, PiN:(OEt)·OPi, is also produced. The following compounds are described:

Picryl *iso*propyl picriminothiocarbonate, melting at 147°, and the corresponding amyl ester (m. p. 138·5°), picrylmethylurethane (192°), picryl-ethylurethane (147°), picryl-*n*-propylurethane (139°), picryl-*iso*propylurethane (177·5°), picryl-*iso*butylurethane (134°), picryl-amylurethane (131°), picryl ethyl picriminocarbonate (222°). Picryl thiocyanate is a crystalline powder which does not melt, but decomposes on heating.

The urethanes are tautomeric, the solutions in associated solvents being coloured, whilst those in non-associated solvents are colourless.

71. "The oxime of mesoxamide (*iso*nitrosomalonamide) and some allied compounds. Part III. Tetra-substituted derivatives." By Martha Annie Whiteley.

In a previous communication (Trans., 1903, 83, 43) reference was made to *iso*nitrosomalondimethylanilide, $C_{17}H_{17}O_3N_3$ (m. p. 109°)—a tetra-substituted derivative of *iso*nitrosomalonamide—and to a compound (m. p. 192°), described as isomeric with it, which was obtained together with the corresponding ketone (m. p. 172°) by the action of nitrosyl chloride on malondimethylanilide. Although the examination of this abnormal reaction is still incomplete, the present note is put forward in consequence of the appearance of a paper on *iso*nitrosomalonamide by Ratz (*Monatsh.*, 1904, 25, 55).

The compound melting at 192° (mol. wt. in naphthalene = 311) has the formula, $C_{17}H_{15}O_3N_3$ or $C_{17}H_{17}O_3N_3$, and on reduction with zinc dust and acetic acid or with aluminium amalgam, yields a compound, $C_{17}H_{17}O_2N_3$ or $C_{17}H_{19}O_2N_3$, which crystallises in colourless, prismatic needles and melts at 185—186°. When treated with alcoholic potassium or sodium hydroxide, it forms crystalline alkali

salts, and from their solutions, mineral acids precipitate a crystalline acid, $C_9H_8O_3N_2$, melting with decomposition at 256°, which yields an *ethyl* ether, $C_9H_7O_3N_2Et$ (mol. wt. in naphthalene = 222), crystallising in octahedral prisms and melting at 168°.

Aminomalondimethylanilide, $(CO{\cdot}NPhMe)_2CH{\cdot}NH_2$, prepared by reducing *iso*nitrosomalondimethylanilide with zinc dust and acetic acid, forms highly refractive prisms melting at 108°.

Nitromalondimethylanilide, $(CO{\cdot}NPhMe)_2CH{\cdot}NO_2$, obtained together with the compound melting at 192° by the action of fuming nitric acid on *iso*nitrosomalondimethylanilide dissolved in chloroform saturated with nitrosyl chloride, forms colourless prisms melting with decomposition at 156°, yields crystalline, yellow alkali salts, and is readily reduced by zinc dust and acetic acid to mesoxdimethylanilide. When boiled with piperidine in alcoholic solution, nitromalondimethylanilide yields a white, crystalline compound melting at 184°, probably *dihydroxymalondimethylanilide*, $(CO{\cdot}NPhMe)_2C(OH)_2$, which has also been prepared from *iso*nitrosomalondimethylanilide by a similar method or by the action of potassium hypobromite.

Malontetraphenylamide, $(CO{\cdot}NPh_2)_2CH_2$, prepared by the action of diphenylamine on malonyl chloride, crystallises in colourless prisms melting with decomposition at 219—220°. The *isonitroso*-derivative, $(CO{\cdot}NPh_2)_2C{:}N{\cdot}OH$, forms pale yellow prisms melting with decomposition at 237—238°. The *potassium* salt, $(CO{\cdot}NPh_2)_2C{:}N{\cdot}OK$, forming slender, yellow needles, gives with ferrous sulphate the rich bluish-purple precipitate characteristic of this group of oximes, and regenerates the *iso*nitroso-compound on treatment with mineral acids or carbon dioxide. The *acetyl* derivative (pale yellow prisms, m. p. 190°), the *benzoyl* derivative (colourless prisms, m. p. 175°), and the *ethyl* ether (m. p. 164—165°) have been prepared. The *amino*-derivative, $(CO{\cdot}NPh_2)_2CH{\cdot}NH_2$, crystallises in colourless prisms and melts at 200—201°.

Nitromalonanilide, $(CO{\cdot}NHPh)_2CH{\cdot}NO_2$ (m. p. 141°), is obtained together with a compound melting at 128° by the action of fuming nitric acid on *iso*nitrosomalonanilide dissolved in chloroform saturated with nitrosyl chloride. The *amino*-derivative, $(CO{\cdot}NHPh)_2CH{\cdot}NH_2$, forms white scales melting at 141—142°.

Malonmonophenylamide, $NHPh{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}NH_2$, crystallises with $\frac{1}{2}H_2O$ and, when anhydrous, melts at 153—154° (Freund gives 163°); the *isonitroso*-derivative, $NHPh{\cdot}CO{\cdot}C(CO{\cdot}NH_2){:}NOH$, forms needles melting at 180—181° with decomposition.

The investigation of the derivatives of *iso*nitrosomalonamide is being continued.

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Page.	Line.	
283	7	*for* "2/3-normal" *read* "normal."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on **Thursday**, May 5th, 1904, at 8 p.m., the following papers will be communicated:

"The slow combustion of ethane." By W. A. Bone and W. E. Stockings.

"Note on the hydrolysis of starch by diastase." By J. S. Ford.

"The resin acids of the *Coniferæ*. Part I. The constitution of abietic acid." By T. H. Easterfield and G. Bagley.

"The action of radium rays on the halides of the alkali metals and analogous heat effects." By W. Ackroyd.

"The dynamic isomerism of glucose and of galactose. Solubility as a means of determining the proportions of dynamic isomerides in equilibrium." By T. M. Lowry.

"A study of the substitution products of *ar*-tetrahydro-α-naphthylamine. 4-Bromo-*ar*-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid." By G. T. Morgan, F. M. G. Micklethwait, and H. B. Winfield.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Classen, A. Ausgewählte Methoden der analytischen Chemie. Unter Mitwirkung von H. Cloeren. Band II. pp. xvi + 831. ill. Braunschweig 1903. From the Publishers.

Curie, Mme. S. Untersuchungen über die radioaktiven Substanzen. Uebersetzt und mit Litteratur-Ergänzungen versehen von W. Kaufmann. pp. viii + 132. Braunschweig 1904. From the Publishers.

Green, Arthur G. A systematic survey of the organic colouring matters. Founded on the German of G. Schultz and P. Julius. 2nd edition. pp. x + 280. London 1904. From the Author.

Guinness Research Laboratory. Transactions. Edited by Horace T. Brown. Vol. I. Part I. pp. 141. ill. 1903.
From Messrs. A. Guinness, Son & Co.

Heumann, Karl. Anleitung zum Experimentieren bei Vorlesungen über anorganische Chemie. Von O. Kühling. Dritte Auflage. pp. xxix + 818. ill. Braunschweig 1904. From the Publishers.

Imperial Institute. Technical reports, and scientific papers. Edited by Wyndham R. Dunstan. With a preface by the late Sir Frederick Abel, Bart. pp. xlvii + 236. London 1903.
From Professor W. R. Dunstan.

Peterson-Kinberg, Willy. Wie eine moderne Teerdestillation mit Dachpappenfabrik eingerichtet sein muss. pp. viii + 224. ill. Wien und Leipzig 1904. From the Publishers.

II. *By Purchase.*

Bischof, Carl. Gesammelte Analysen der in der Thonindustrie benutzten Mineralien und der daraus hergestellten Fabrikate. pp. 165. Leipzig 1901.

Böhmer, C. Die Kraftfuttermittel, ihre Rohstoffe, Herstellung, Zusammensetzung, Verdaulichkeit und Verwendung, mit besonderer Berücksichtigung der Verfälschungen und der mikroskopischen Untersuchung. pp. xi + 650. ill. Berlin 1903.

Gildemeister, Eduard, and Hoffmann, Friedrich. The volatile oils. Authorised translation by Edward Kremers. pp. 733. ill. Milwaukee 1900.

Maercker, Max. Handbuch der Spiritusfabrikation. Achte, vollständig neubearbeitete Auflage, hrsg. von Dr. Max Delbrück. pp. xx + 940. ill. Berlin 1903.

Mann, J. Dixon. Forensic medicine and toxicology. 3rd edition, revised and enlarged. pp. 692. ill. London 1902.

Nernst, Walther. Theoretische Chemie vom Standpunkte der Avogadroschen Regel und der Thermodynamik. 4 Aufl. pp. xiv + 749. ill. Stuttgart 1903.

Oppenheimer, Carl. Die Fermente und ihre Wirkungen. 2 Aufl. pp. viii + 440. Leipzig 1903.

Robine, R., et Lenglen, M. L'industrie des cyanures. Étude théorique et industrielle. pp. 463. ill. Paris 1903.

Schmidt, Julius. Ueber die basischen Eigenschaften des Sauerstoffs und Kohlenstoffs. pp. 111. Berlin 1904.

Seger, Hermann August. Gesammelte Schriften. Herausgegeben von H. Hecht und F. Cramer. pp. xv + 908. Berlin 1896.

Swithinbank, Harold, and Newman, George. Bacteriology of milk. With special chapters on the spread of disease by milk and the control of the milk supply. pp. xx + 605. ill. London 1903.

Tammann, Gustav. Kristallisieren und Schmelzen. Ein Beitrag zur Lehre der Änderungen des Aggregatzustandes. pp. x + 348. ill. Leipzig 1903.

Walker, James. Introduction to physical chemistry. 3rd ed. pp. 368. ill. London 1903.

Weber, Wilhelm, und Kohlrausch, Rudolf. Fünf Abhandlungen über Absolute elektrische Strom- und Widerstandsmessung. Herausgegeben von Friedrich Kohlrausch (Ostwald's *Klassiker*, No. 142). Leipzig 1904.

III. *Pamphlets.*

Atwater, W. O., and Benedict, F. G. Experiments on the metabolism of matter and energy in the human body. (U. S. Dept. of Agriculture, Office of Experiment Stations. Bulletin No. 136.) Washington 1903.

Baskerville, Charles. The elements: verified and unverified. (From the *Proc. Amer. Assoc. Advance. Sci.*, 53, 1904.)

Baskerville, Charles, and Kunz, George F. Effects on rare earth oxides produced by radium-barium compounds and on the production of permanently luminous preparations by mixing the latter with powdered minerals. (From the *Amer. J. Sci.*, 17.)

Baskerville, Charles, and Turrentine, J. W. Contributions to the chemistry of the rare earths. (From the *J. Amer. Chem. Soc.*, 26.)

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 5th, 1904.

Barbour William, M.A., B.Sc.
Grove Villa, Waltham Cross.

Chemist, Royal Gunpowder Factory, Waltham Abbey, Essex. Medallist in Mathematics and Chemistry and Berry Scholar in Science, St. Andrews; joint author with Professor Purdie of paper on "The Influence of Solvents on the Rotatory Powers of Dimethoxysuccinates and Tartrates" (Trans., 1901, vol. 79); Science master, Grammar School, Southwell, Notts.; chemist, R.G.P.F., since July, 1901.

Thomas Purdie. Alex. Findlay.
Alex. McKenzie. G. Druce Lander.
James Walker.

Benn, R. H. Durward,
Westmount, Montreal, Canada.

Analytical Chemist, with Dr. J. T. Donald, Dom. Govt. Analyst. Engaged in the study and practice of Pharmaceutical and Analytical Chemistry over eight (8) years. Studied partially at McGill University and partially at Bishop's College. Member Soc. Chem. Industry, Canadian Sect.

B. J. Harrington. T. E. Vasey.
J. Bemrose. *G. P. Girdwood.*
Jeffrey H. Burland.

Bridgett, Robert Currie,

32, Queen Anne Street, Dunfermline, Fifeshire.

Science and Mathematical Teacher, The Academy, Rothesay, N.B. M.A., B.Sc. St. Andrews. Late Berry Scholar in Chemistry, St. Andrews. Joint author with Professor Purdie, St. Andrews, of a paper entitled "Trimethyl α-Methylglucoside and Trimethyl Glucose" (Trans., 1903, 83, 1037).

Thomas Purdie. G. D. Lander.
Alex. McKenzie. W. A. Greaves.

James Walker.

Clayton, Ellis,

6, Spring Hurst Road, Saltaire.

Chemist to Messrs. Sir Titus Salt., Bart., Sons & Co., Ltd., Saltaire. Late Demonstrator in Dyeing, Bradford Municipal Technical College. Three years assistant dyer and chemist, Newton Bank Print Works, Hyde. In 1899 held local scholarship of the value of £10 (Worshipful Company of Drapers) in Chemistry and Physics at the Haginbottom Technical School, Ashton-u.-Lyne. In 1900 obtained 1st place and silver medal in Honours calico printing (City and Guilds), and was awarded the Dyers Scholarship, value £63 per annum for 3 years, open to all those in England engaged in dyeing, printing, &c., and tenable in the Chemistry and Dyeing Department of the Bradford Municipal Technical College. Contributed two papers on dyeing, &c., to the Journal of the Society of Dyers and Colourists. In 1903 obtained Diploma of the Bradford College, and silver medal in silk-dyeing, 1st place Honours (City and Guilds). Have taken 1st class advanced certificates in practical and theoretical Inorganic and Organic Chemistry (Board of Education), and also 1st class Honours certificates in Cotton Dyeing, Wool Dyeing, Silk Dyeing, Calico and Linen Bleaching, and Calico Printing under the City and Guilds of London Institute.

George W. Slatter. Barker North.
Walter M. Gardner. A. B. Knaggs.

Samuel F. Stell.

Finlow, Robert Steel,

* The Research Station, Pemberandah, Daleingh Serai Tirhoot State Railway, Bengal.

Assistant Chemist at the above Research Station. General Education at Sandbach School, Cheshire (1887—1893). Proceeded to University College, Bangor, 1893. Graduated B.Sc. (Wales) 1899.

* This Research Station is supported entirely by the Government of Bengal.

Private Assistant to Professors Dobbie and Hartley in their work on "Absorption Spectra of Organic Compounds," 1899—1900. Assistant Chemist under Dr. Geo. McGowan to the Royal Commission on Sewage Disposal, 1900—1903. Assisted Dr. McGowan in his work for the Royal Commission on Arsenical Poisoning, 1901—1903. Joint author with Dr. McGowan of the following papers: (1) "Methods Employed in Testing for Arsenic in various Samples of Foods and other Substances . . . . "; (2) "Mechanical Analysis of Soils and Subsoils, together with deductions drawn from this" (in course of publication). At present engaged with Professor Bloxam at the Dalsingh Serai Research Station, in the investigation of the chemistry of Indigo.

James J. Dobbie. — W. Popplewell Bloxam.
George McGowan. — Alexander Lauder.
William Ramsay. — R. B. Floris.
W. N. Hartley. — Morris W. Travers.

Hammond, Harold Sankey,

Government Laboratory, Kingston, Jamaica.

Assistant to the Government Analytical and Agricultural Chemist in Jamaica. Worked for two years with Mr. Sidney Harvey, Public Analyst. Obtained Diploma of S.E. Agricultural College, Aug., 1899, "Experiments upon the Effect of Boracic Acid and Formalin upon the Live Weight, Growth, and Food Assimilation of Young Pigs," by A. D. Hall and H. S. Hammond; in collaboration with Professor Tunnicliffe, M.D. (Report of the Committee on Food Preservatives). "The Determination of Available Phosphoric Acid and Potash in Calcareous Soils," by H. H. Cousins and H. S. Hammond (*Analyst*, Aug., 1903.)

Sidney Harvey. — E. J. Russell.
A. D. Hall. — H. H. Cousins.
Albert Howard. — *N. H. J. Miller.*

Bernard Dyer.

Horn, George Mathieson,

Ivylands, Epping.

Analytical Chemist. Eighteen months at Marburg University, Hessen-Nassau, Chemistry. Two years at S.E.A. College, Wye, studying Technical Chemistry.

Alfred Edward Beanes. — W. S. Simpson.
F. Evershed. — *R. J. Friswell.*

John Spiller.

Le May, Percy Kent,

6, Lothair Villas, Hatfield, Herts.

Head Brewer to the Hatfield and Harpenden Breweries, Limited. Have studied Chemistry as applied to Brewing and Malting under Mr. John Heron at his Laboratory, 110, Fenchurch Street, and am desirous of being admitted to the Chemical Society in order to extend my knowledge of Pure Chemistry. I am continually at work in the Laboratory here.

Lyndon C. Wilson. Alfred C. Young.
John Heron. *Leonard Temple Thorne.*
Francis Jewson. *E. Haynes Jeffers.*

Mander, Alfred,

Berkswell, Malvern.

Pharmaceutical Chemist. Bell Scholar 1887. Chemistry, 1st course, 1st Certificate of Honour. Botany, 1st course, 1st Certificate of Honour. Session Chemistry, 1st Certificate of Honour. Botany, Silver Medal; Pharmacy, Silver Medal; Practical Chemistry, 3rd Certificate of Honour, 1888. Major Examination, 1888. Pharmaceutical Society's Medal (Silver), 1889. Pharmacist in analytical work. Author of "The Analysis of Snow" (*Pharm. Journal*, 1891), "Ghatti and other substitutes for Gum Arabic" (*Pharm. Journal*, 1888), "The Climate of Malvern" (Stevens & Co.), 1903. Elected Fellow of the Royal Meteorological Society, November, 1899.

John Attfield. Joseph Ince.
Wyndham R. Dunstan. *Thomas A. Henry.*
Ernest Goulding.

Moore, Tom Sidney,

99, Rann Street, Ladywood, Birmingham.

Lecturer and Demonstrator in Chemistry at the University of Birmingham. B.A. (Oxford 1st Class Hons. in School of Nat. Sci.), 1902. B.Sc. (London, 1st Class Hons. and Scholarship in Chemistry), 1903. *Published papers*: Uber die Salz- und Hydrat-Bildung der Azophenole [with J. T. Hewitt and A. E. Pitt] (*Ber.*, 1898, pp. 2114—2123), The Reversibility of Voltaic Cells (*Phil. Mag.*, 1900, pp. 491—496), Modification of Zeisel's Method for Estimation of Methoxyl Groups [with J. T. Hewitt] (*J. C. S.*, 1902, pp. 318—321).

Percy. F. Frankland. Alex. Findlay.
J. T. Hewitt. Alex. McKenzie.
Thomas H. Pope.

Smith, Gerald Oscar Morgan,

The Studio, Trowse, Norwich.

Science Master. Studied Chemistry for three years at the Manchester Technical School. Teacher of Science in the Wallingford Grammar School for two years. Board of Education advanced Certificates for Inorganic Chemistry (Pract. and Theor.), and Metallurgy (Pract.). City and Guilds of London Institute Certificate for Science of Brewing. At present waiting for the Examination for post of Assistant Chemist at Woolwich.

George Embrey. Jas. Grant.
R. S. Cahill. *J. M. Collett.*

E. C. Womersley.

Oldfield, Laurel Cecil Francis,

Lincoln College, Oxford.

Student of Chemistry.

H. Brereton Baker. N. V. Sidgwick.
Allan F. Walden. R. Tabor Lattey.

D. H. Nagel.

Page, William Davidge,

Constitutional Club, London, W.C.

Engineer. Proprietor of a monthly technical journal, "Page's Magazine." Interest in Chemistry. Desirous of attending Meetings and of receiving the Transactions, and of making use of the Library.

David. A. Louis. F. Evershed.
J. Lewkowitsch. *Frederick Jas. M. Page.*

R. J. Friswell.

Pinchbeck, Gerald,

96, Albany Street, Regent's Park, N.W.

Pharmaceutical and Analytical Chemist. Major graduate of the Pharmaceutical Society. Member of the Pharmaceutical Society. Late Demonstrator in practical Chemistry and Physics at the London College of Chemistry. Contributor of the following scientific articles and notes published in the *Pharmaceutical Journal*:—"Arsenic in Sulphuric Acid" (1900), "Floral Calendar for January" (1899), "A Curious Hypertrophy of *Citrus Aurantium Risso*" (1903), "The Morphology and Pharmacognosy of *Berberis vulgaris*" (1900).

J. Bernard Coleman. J. Archyll Jones.
John M. Thomson. *Walter Hills.*

F. Stanley Kipping.

Porter, Thomas Linton Daniel,
161, Downsell Road, Stratford New Town.

Schoolmaster. For 2 years a Science Student at King's College, London. Medallist and Exhibitioner in Natural Science, King's College. For the past 2½ years Head Science Master at the Park Higher Grade School, Ilford, Essex. Bachelor of Science, London University.

John M. Thomson. Patrick H. Kirkaldy.
Herbert Jackson. W. D. Halliburton.
D. Northall-Laurie.

Riley, Louis John Ezekiel,
Port of Spain, Trinidad, B.W.I.

Student of Chemistry. Received general education at St. Mary's College, Port of Spain, Trinidad, B.W.I., obtaining Junior and Senior Cambridge Local Examination Certificates in 1896 and 1897 respectively. Studied Chemistry and allied subjects at University of Edinburgh during 1899–1901. Same studies were continued at the Glasgow and West of Scotland Technical College, 1900–1903. Passed the Intermediate Examination of the Institute of Chemistry, July, 1903, and now preparing for the Final Examination of the Institute at King's College, London.

John M. Thomson. Thomas Gray.
G. G. Henderson. Herbert Jackson.
Patrick H. Kirkaldy.

Robertson, Franklin Ernest,
Gloster House, Harders Road, Peckham, London, S.E.

Chemist and Manager of Dyeing (father's business). Studied Chemistry and Dyeing at the Bradford Municipal Technical College under Mr. W. M. Gardner, Dr. Sutherst, Dr. A. W. Gilbody, and Mr. Knaggs, taking a special two years' course. Holder at the College of the Dreyfus Scholarship, open to all engaged in the dyeing trade. Have the Chemistry and Dyeing certificates of the Bradford College, Board of Education advanced Certificate in Chemistry, City and Guilds Honours in Silk and Cotton and ordinary Certificates in Wool dyeing. Since leaving the College have continued my studies in Dyeworks in Zurich, Elberfeld (Bayers), Barmen and under Mr. Loewenthal at Cassella's (Frankfort). Author of "Note on the Effect of Sodium Chloride in the Estimation of free Alkaline Hydrate and Carbonate in Soap," Published *Journ. Soc. Dyers and Colorists*, July, 1901.

C. F. Cross. Walter M. Gardner.
Fredk. Hudson-Cox. A. B. Knaggs.
B. North.

Shacklady, Thomas George,

Addiscombe Villas, Cliff-at-Hoo, Rochester, Kent.

Technical chemist. Chief chemist Messrs. Curtis and Harvey, Explosive Factory, Cliffe. Member Society of Chemical Industry.

W. B. Roberts. E. Dowzard.
F. H. Tate. *Fred. R. Stone.*
Charles J. Smith.

Smith, Clarence,

Denmark Lodge, St. James', Hatcham, S.E.

Lecturer at E. London Technical College, Mile End Road. 1897—9 Teaching-Scholar, Royal College of Science, S. Kensington. 1903. Lecturer and Demonstrator, University College, Gower Street. 1903—present time, Lecturer and Demonstrator, E. London Technical College. D.Sc. (Lond. 1903). Thesis: *ar*-Tetrahydro-β-naphthylamine.

William A. Tilden. H. Burrows.
J. T. Hewitt. Chapman Jones.
G. T. Morgan. James C. Philip.

Smith, Henry Heron,

76, Plumstead Common Rd., Plumstead.

Analytical Chemist. 1st Assistant Metallurgist, Royal Gun Factories, Royal Arsenal, Woolwich.

Wesley J. Lambert. W. Kellner.
Richard J. Redding. J. C. Aylan.
H. Russell Pitt. A. H. Mundey.

Stanger, Reginald Harry Hursthouse,

33, Ladbroke Grove, London, W.

Inspecting, Testing, and Consulting Engineer, and in conjunction with his engineering profession engaged in carrying out investigations, &c., at his Chemical Laboratories and Testing Works, 2, Broadway, Westminster, S.W.

Horace T. Brown. L. Pyke.
Henry E. Armstrong. *H. Harding.*
Gerald T. Moody. *William Robertson.*

de Jersey Fleming-Struthers, Robert,

Exeter College, Oxford.

B.A. of Oxford University. Has studied Chemistry for four years at Oxford University, and graduated with Honours in this subject.

Is at present engaged in research work on Chemistry with Mr. Marsh.

John Watts. W. W. Fisher.
William Odling. Allan F. Walden.
J. E. Marsh.

Tong, Walter,

"Holmdene," Pole Lane, Failsworth, Manchester.

Analyst, &c., in the employ of Messrs. Grimshaw Bros. & Co., Ltd., Clayton, Manchester. I have studied Chemistry 3 years at the Municipal School of Technology, having obtained Hons. Part I Inorganic (Practical); also part author of a paper read before the Society of Chemical Industry (Manchester Section), March, 1903, on the Analysis of Manufactured India-rubber. The paper was read by Messrs. Grimshaw, Tong, & Barnes.

William J. Pope. F. S. Sinnatt.
John Allan. J. H. Wolfenden.
L. G. Radcliffe. Stanley J. Peachey.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 14/5/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 280.

May 5th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. C. M. Beadnell, C. T. Bennett, and T. U. Walton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

W. Eddington Field, 65, Sutherland Road, Armadale, Melbourne, Victoria, Australia.

John Hulme, 3, Albert Terrace, Stockport.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

William Barbour, M.A., B.Sc.
R. H. Durward Benn.
Robert Currie Bridgett, M.A., B.Sc.
Ellis Clayton.
Robert Steel Fiulow, B.Sc.
Harold Sankey Hammond.
George Mathieson Horn.
Percy Kent Le May.
Alfred Mander.
Tom Sidney Moore, B.A., B.Sc.
Gerald Oscar Morgan Smith.
Lauiel Cecil Francis Oldfield.
William Davidge Page.
Gerald Pinchbeck.
Thos. Linton Daniel Porter, B.Sc.
Louis John Ezekiel Riley.
Franklin Ernest Robertson.
Thomas George Shacklady.
Clarence Smith, D.Sc.
Henry Heron Smith.
Reginald Harry H. Stanger.
Robert de J. Fleming-Struthers, B.A.
Walter Tong.

The PRESIDENT announced that the following persons were proposed by the Council for election as Foreign Members.

Henri Becquerel.	Madame Marie Curie.
Cornelis Lobry de Bruyn.	Carl Liebermann.
Frank Wigglesworth Clarke.	Edward Williams Morley.

and stated that in accordance with Bye-Law II. the ballot for their election would take place at the next meeting of the Society on Wednesday, May 18th.

The PRESIDENT announced that the following letter had been received from Sir Henry Roscoe in reply to the address of congratulation from the Society on the occasion of the celebration of the Jubilee of his Doctorate.

"'To the Council and Fellows of the Chemical Society I offer my hearty thanks for the honour they have done me through the President, Professor Tilden.

'Instituted in 1841 for the purpose of stimulating chemical research in this country by the leaders of our science of that day, amongst whom Thomas Graham stands pre-eminent, the influence which the Society has exerted during more than half a century on the progress of English Chemistry has been far greater than its Founders could have foreseen.

'During the last fifty years our Science has undergone not one but many revolutions, each one widening and deepening its foundations.

'In this wonderful series of changes, thanks to the zeal and ability of its Fellows, both young and old, the Chemical Society has borne no inconsiderable part, and for its still wider influence and its still greater activity no one has warmer wishes than myself.

(Signed) HENRY E. ROSCOE.'"

Of the following papers, those marked * were read:

***72. "The slow combustion of ethane." By William Arthur Bone and William Ernest Stockings.**

The authors have studied (1) the interaction of ethane and oxygen at 250—400°, under pressures of 1·75 to 2·33 atmospheres, in borosilicate glass bulbs (compare *Trans.*, 1902, 81, 536); (2) the oxidation of ethane in contact with a surface of porous porcelain at 400—500°, under reduced pressure, in the circulation apparatus described in a previous paper (*Trans.*, 1903, 83, 1074), and (3) the slow combustion

of ethyl alcohol and acetaldehyde. The main conclusions deduced from the experiments are as follows :

(1) The proportions of ethane and oxygen most favourable to chemical change are equimolecular (1 : 1), although interaction takes place nearly as rapidly in mixtures containing ethane and oxygen in the ratio 2 : 1. At all temperatures, ethane is oxidised much more rapidly than is methane, other conditions being equal.

(2) When ethane is treated with proportions of oxygen insufficient to oxidise the whole to carbon monoxide and steam, there is no preferential combustion either of hydrogen or carbon. In the absence of secondary phenomena, the interaction is always marked by a diminution in the pressure of the cold products without any deposition of carbon or liberation of free hydrogen.

(3) The combustion proceeds in several well-defined stages, among which the following have been distinguished :

(i) A primary oxidation to acetaldehyde and steam.

(ii) A further rapid oxidation of the acetaldehyde to formaldehyde, carbon monoxide, and steam.

(iii) The final oxidation of formaldehyde to carbon monoxide, carbon dioxide, and steam, which may best be considered as due to two simultaneous interactions (i) $CH_2O + O_2 = CO_2 + H_2O$, (ii) $2CH_2O + O_2 = 2CO + 2H_2O$.

(4) The combustion of the hydrocarbon may be accompanied by the following secondary phenomena :

(i) Hydrogen or methane, or both, may appear in the products without any liberation of carbon, as the result of the purely thermal decompositions of formaldehyde and acetaldehyde vapours respectively, the latter giving rise to methane and carbon monoxide, whilst the former yields hydrogen and carbon monoxide, although its decomposition is a more complex process than that of acetaldehyde.

(ii) Small quantities of ethylene and hydrogen may appear in the products as the result of the thermal decomposition of ethane.

(iii) If the heat liberated during the initial stages of oxidation is sufficient to raise the temperature of the interacting gases to the ignition point, an explosion takes place, during which the excess of hydrocarbon, and probably also of aldehyde vapours, is decomposed, carbon and hydrogen being liberated together with some acetylene and ethylene. There is no liberation of carbon below the ignition point.

(5) Although ethyl alcohol has not been detected among the oxidation products of ethane, its absence may be explained by the fact that it is oxidised far more rapidly than is ethane under similar conditions.

(6) The view taken of the mechanism of the combustion of ethane is supported by the experiments on ethyl alcohol and acetaldehyde.

***73. "The action of radium rays on the halides of the alkali metals and analogous effects produced by heat." By William Ackroyd.**

The author has studied the action of γ-rays from radium bromide, in its violet glass tube, on the chlorides of lithium, sodium, potassium, rubidium and cæsium, and deduces the following conclusions:

(1) The colour changes produced divide the compounds into two sub-groups: I. LiCl, NaCl, and II. KCl, RbCl, CsCl, and in the effects observed: LiCl, white; NaCl, orange; KCl, violet; RbCl, bluish-green, and CsCl, green, each sub-group conforms to the constitutive-colour law (*Chem. News*, 1893, 67, 27).

(2) The division into these sub-groups is also indicated by their differences of molecular aggregation as expressed by 1/sp. vol.

(3) There is relative stability of the colours produced while they remain in darkness, and their rate of disappearance or decay in daylight varies with the intensity of the light.

(4) The relative expenditure of energy in the γ-rays effecting the colour changes decreases with increase of molecular weight, or, in other words, the sensibility to the action of the γ-rays increases with the molecular weight.

(5) When the induced phosphorescence has decayed so as to be no longer visible, it can be revived by invisible heat. In the case of fused lithium chloride, a temperature of 37° is sufficient for the purpose.

(6) These various features correspond in many respects with the thermal effects produced in other substances, and the whole of the evidence points to the conclusion that both are physical changes.

***74. "The mutarotation of glucose and of galactose. Solubility as a means of determining the proportions of dynamic isomerides in equilibrium." By Thomas Martin Lowry.**

The method formerly described (*Proc.*, 1903, 19, 156) and applied to the case of β-bromonitrocamphor has now been used in order to determine the proportion of α-glucose and of α-galactose in the mixtures of dynamic isomerides which are formed when these sugars are dissolved in alcohol or in water. The solubility of α-glucose in anhydrous methyl alcohol gradually increases in the course of a week in the ratio of 0·53 : 1 and that of α-galactose in the ratio 0·50 : 1. The increment of solubility is due to the formation in solution of the stereoisomeric β-glucose (Tanret's γ-glucose) and β-galactose; when equilibrium is reached, the quantity of sugar in solution is nearly twice

as great as when the α-form alone is present, and the stereoisomerides must therefore be in approximately equal proportion and be almost equally stable. This result differs from that obtained by Jungius in the case of the methyl-glucosides, for which the ratio was found to be $\alpha:\beta = 3:1$ instead of 1 : 1.

In a mixture having approximately the composition $EtOH + H_2O$, the solubility of α-galactose was found to increase in the ratio 0·39 : 1, and in a mixture having approximately the composition $PrOH + 2H_2O$ in the ratio 0·35 : 1. The decrease of the ratio in the aqueous-alcoholic solutions may be attributed to the presence in the solution, along with the stereoisomeric α- and β-galactoses, of a considerable proportion of the hydrated aldehydic form of the sugar, which is probably an intermediate product in the isomeric change (compare *Trans.*, 1903, **83**, 1316); this conclusion is in harmony with the fact that the rate of change is many times greater than in the anhydrous methyl-alcoholic solutions.

Similar experiments were made on the dissolution of α-glucose in mixtures having approximately the composition $2EtOH + H_2O$ and $EtOH + H_2O$, but in each case the gradual increase of solubility was preceded by a more or less rapid decrease owing to the conversion of the solid α-glucose into a less soluble hydrate.

*75. **"A study of the substitution products of *ar*-tetrahydro-α-naphthylamine. 4-Bromo-*ar*-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid."** By **Gilbert Thomas Morgan, Frances Mary Gore Micklethwait, and Herbert Ben Winfield.**

The acyl derivatives of *ar*-tetrahydro-α-naphthylamine (Bamberger and Althause, *Ber.*, 1888, **21**, 1895), when brominated with one molecular proportion of the halogen or hypobromous acid, ultimately undergo substitution in the aromatic ring, the entrant bromine atom assuming the para-position with respect to the aminic nitrogen. The bromo-base obtained on hydrolysis was shown to be 4-*bromo*-ar-*tetrahydro-α-naphthylamine* (m. p. 42°) by furnishing successively 1-bromotetrahydronaphthalene and 1-*bromodinitrotetrahydronaphthalene* (m. p. 91°). The isomeric 2-*bromodinitrotetrahydronaphthalene* prepared from *ar*-tetrahydro-β-naphthylamine for the purpose of comparison melted at 105—106°. On treatment with diazo-compounds, the bromo-base yields diazoamines of the type $C_{10}H_{10}Br{\cdot}NH{\cdot}N_2X$. For example, 4 : 4′-*dibromo*-1-*diazo*-1-*aminotetrahydronaphthalene* prepared by the interaction of the base with its own diazonium salt, decomposes violently at 190—194°, and when treated with cold concentrated hydrochloric acid undergoes fission, yielding the hydrochlorides of its

generators, the diazonium chloride being identified by the formation of 4-*bromotetrahydronaphthaleneazo-β-naphthol* (m. p. 215°).

4-Bromo-α-naphthylamine, unlike the analogously substituted tetrahydro-base, condenses with diazo-compounds to form ortho-azo-derivatives having the general formula $XN_2 \cdot C_{10}H_5Br \cdot NH_2$. The *azo-compound*, $NaSO_3 \cdot C_6H_4 \cdot N_2 \cdot C_{10}H_5Br \cdot NH_2$, yields, on reduction, sulphanilic acid and naphthylene-1 : 2-diamine.

ar-*Tetrahydro-α-naphthylamine-4-sulphonic acid*,

$$NH_2 \cdot C_{10}H_{10} \cdot SO_3H, H_2O,$$

produced by sulphonating *ar*-tetrahydro-α-naphthylamine, was converted into *tetrahydronaphthalene-1-sulphonic acid* by eliminating its amino-group, the same product being also obtained by replacing this radicle in *ar*-tetrahydro-α-naphthylamine by the SO_3H group and oxidising the *tetrahydronaphthalene-1-sulphinic acid* thus produced. *Tetrahydronaphthalene-1-sulphonic chloride* and the corresponding *anilide* melt at 70·5° and 144—145° respectively.

ar-Tetrahydro-α-naphthylamine-4-sulphonic acid differs from α-naphthylamine-4-sulphonic (naphthionic) acid in yielding diazoamino-derivatives and not azo-compounds.

The azo-derivatives of *ar*-tetrahydro-α-naphthylamine were shown to be para-azo-compounds like the corresponding azo-α-naphthylamines, for, on reduction, they give rise to *ar*-tetrahydronaphthylene-1 : 4-diamine.

These results indicate that although *ar*-tetrahydro-α-naphthylamine resembles α-naphthylamine in forming para-azo-compounds with greater facility than a benzenoid amine, yet its para-substituted derivatives, unlike those of α-naphthylamine, do not yield ortho-azo-compounds, and in this respect behave like *p*-bromoaniline and other similarly substituted bases of the benzene series.

***76. "Studies in the tetrahydronaphthalene series. Part II. Halogen derivatives of *ar*-tetrahydro-β-naphthylamine." By Clarence Smith.**

In a previous paper (*Trans.*, 1902, 81, 900), it was shown that *ar*-tetrahydro-β-naphthylamine resembles primary benzenoid amines in giving diazoamino-compounds, and this resemblance is exemplified further in its behaviour towards the halogens.

Aceto-β-naphthalide yields only 1-bromoaceto-β-naphthalide at the ordinary temperature, even with excess of bromine. *ar*-Tetrahydroaceto-β-naphthalide reacts with one molecular proportion of bromine to form two compounds, namely, 1-bromo-*ar*-tetrahydroaceto-β-naphthalide and 4-bromo-*ar*-tetrahydroaceto-β-naphthalide.

The following compounds have been prepared:

1-*Bromotetrahydronaphthalene*, $C_{10}H_{11}Br$, obtained from *ar*-tetra-

hydro-*a*-naphthylamine by the Sandmeyer reaction, is a colourless, refractive liquid with an odour resembling that of halogen compounds of the benzene series; it is volatile in steam and dissolves readily in organic solvents (b. p. 255—257°/751 mm.).

2-*Bromotetrahydronaphthalene*, prepared from *ar*-tetrahydro-β-naphthylamine, resembles the preceding compound and boils at 238—239° under 758 mm. pressure.

1-*Bromo*-ar-*tetrahydroaceto-β-naphthalide*, $C_{12}H_{14}ONBr$, resulting from the action of one molecular proportion of bromine on an equivalent quantity of *ar*-tetrahydroaceto-β-naphthalide dissolved in glacial acetic acid, separates from alcohol in colourless, octahedral crystals (m. p. 125·5°).

4-*Bromo*-ar-*tetrahydroaceto-β-naphthalide*, obtained from the mother liquor in the preparation of the preceding isomeric 1-bromo-compound, separates from alcohol in colourless needles (m. p. 151°).

1-*Bromo*-ar-*tetrahydro-β-naphthylamine*, $C_{10}H_{12}NBr$, is prepared by hydrolysing the corresponding acetyl derivative; it separates from light petroleum in colourless, silky needles (m. p. 52·5°). It dissolves easily in alcohol or acetone, and is volatile in steam.

4-*Bromo*-ar-*tetrahydro-β-naphthylamine* crystallises from light petroleum in colourless needles (m. p. 52°); it is not readily volatile in steam.

***77. "Studies in the tetrahydronaphthalene series. Part III. Reaction between *ar*-tetrahydro-β-naphthylamine and formaldehyde." By Clarence Smith.**

Evidence of the benzenoid nature of *ar*-tetrahydro-β-naphthylamine is obtained from the study of the behaviour of the base towards formaldehyde. The product is methylene-*ar*-tetrahydro-β-naphthylamine, analogous to methyleneaniline. There is no tendency to produce an acridine, which would be evidence of its naphthalenoid character.

The following compounds have been prepared:

Methylene-ar-*tetrahydro-β-naphthylamine*, $(C_{11}H_{13}N)_3$, is obtained together with a polymeric modification, $(C_{11}H_{13}N)_x$, when a solution of formaldehyde is added slowly to *ar*-tetrahydro-β-naphthylamine. The trimolecular form separates from acetone or light petroleum as a felted mass of small, white needles; it melts at 121° and gives an intense blood-red coloration with glacial acetic acid.

The polymeric modification is a white, amorphous powder which, when heated, darkens at 156° and fuses at 164°. It is almost insoluble in acetone, light petroleum or benzene, but dissolves in hot alcohol and becomes converted mainly into the trimolecular form.

Methyl-ar-*tetrahydro-β-naphthylamine*, $C_{10}H_{11}\cdot NH\cdot CH_3$, obtained by

the reduction of methylene-*ar*-tetrahydro-β-naphthylamine by sodium and amyl alcohol, is a colourless, refractive, oily liquid which boils at 267·5° under 210 mm. pressure. The *hydrochloride*, $C_{11}H_{15}N,HCl$, crystallises from water in white needles. The *nitrate*, $C_{10}H_{15}N,HNO_3$, separates in needles when an ethereal solution of the base is shaken with dilute nitric acid. The *nitrosoamine*, $C_{10}H_{11}N(CH_3)\cdot NO$, is a yellow oil, which gives Liebermann's reaction.

78. "Note on the hydrolysis of starch by diastase." By John Simpson Ford.

The writer finds that Kjeldahl's "law of proportionality" is true for the diastase of barley and air-dried malt, as well as for that of kiln-dried malt.

79. "The resin acids of the *Coniferæ*. Part I. The constitution of abietic acid." By Thomas Hill Easterfield and George Bagley.

The resin acids of the *Coniferæ* as a class have the following points in common: (1) they readily become superfused, and then set to a resin or glass, which crystallises if fused and maintained for some time at a temperature slightly above the initial melting point; (2) they nitrate without difficulty in glacial acetic acid solution; (3) in a fused state, they readily absorb oxygen from the air; (4) their esterification velocity is extremely low; (5) with hydriodic acid, they yield hydrocarbons of nearly the same composition as the diterpenes, with which they have erroneously been regarded as identical.

Colophony, on distillation under diminished pressure or in superheated steam, yields a product which gives analytical results agreeing accurately with those required for abietic acid (m. p. 160—165°).

By the slow distillation of abietic acid, even under reduced pressure, a hydrocarbon, $C_{18}H_{28}$, is produced, which is undoubtedly the "colophene" obtained by Deville on distilling colophony, but is not the "colophene" which the same author produced by polymerising turpentine by means of sulphuric acid. In order to avoid ambiguity, the name "abietene" is proposed for the compound derived from abietic acid.

Krämer and Spilker, by distilling colophony under pressure, obtained a hydrocarbon to which they assigned the formula $C_{18}H_{28}$, regarding it as being derived from abietic acid by the loss of carbon dioxide.

Abietene, $C_{18}H_{28}$, boils at 199—200° (13 mm.), 247—250° (82 mm.), 340—345° (760 mm.), has a sp. gr. 0·973 at 19°/19°, and n_D 1·537 at

20°; it is thus identical with the "diterebenthyl" ($C_{20}H_{30}$?) which Renard (*Compt. rend.*, 1887, **105**, 865) isolated from resin oil.

Abietene is produced when abietic acid is heated with fuming hydriodic acid at 200°; the gases formed at the same time have been analysed and were found to consist of 90 per cent. of carbon monoxide and dioxide approximately in the ratio $9CO : 1CO_2$, the volume of oxides of carbon formed after 2 hours' heating being 80 per cent. of that required for the elimination of one carboxyl group from abietic acid.

Abietene, when distilled with one-third of its weight of sulphur, yields a small quantity of retene (m. p. 99°), but with twice this proportion of sulphur an isomeric hydrocarbon is obtained melting at 86°; at the same time, a hydrocarbon boiling at 330—360° (30 mm.) is produced, which is still under examination. If the distillation with sulphur is conducted under reduced pressure, retene is the principal product. These two hydrocarbons are also formed by distilling Merck's "retene puriss." with one-fifth of its weight of sulphur.

The foregoing observations support the view that hydrogenated retenes are probably normal constituents of resin oil (*Ber.*, 1889, **22**, 3368; 1903, **36**, 647), and that resin oil is undoubtedly a hydrogenated retene.

This conclusion is further strengthened by the observation that abietene, when reduced with hydriodic acid and excess of phosphorus at 240°, takes up two atoms of hydrogen and yields a hydrocarbon, dihydroabietene, which appears to be identical with the dodecahydroretene obtained by Liebermann and Spiegel (*Ber.*, 1889, **22**, 779) by reducing retene under similar circumstances.

The above observations lead to the conclusion that abietic acid is decahydroretenecarboxylic acid, but the accepted formula for retene would not account for its low esterification velocity. There is, however, no experimental evidence for the assumed para-position of the methyl and *iso*propyl groups in retene. That these groups are really in the meta-position in abietic acid and in retene is rendered probable by the observation of Kolbe (*Ber.*, 1880, **13**, 888) that resin spirit is rich in *m*-cymene, but contains only small quantities of ordinary cymene.

80. **"The additive products of benzylideneaniline with ethyl acetoacetate and ethyl methylacetoacetate." By Francis Ernest Francis and Miss Millicent Taylor.**

It was shown that the additive product of benzylideneaniline and ethyl methylacetoacetate exists in one form only, being unaffected in solution by traces of either piperidine or sodium ethoxide. This confirms Schiff's view of the constitution of such substances. The various data

in connection with the additive products from ethyl acetoacetate and benzylideneaniline were indicated, and Morrell and Bellars' work on the subject was criticised.

81. "Studies on ethyl carboxyglutarate. Part I. Action of halogens on ethyl sodiocarboxyglutarate." By Oswald Silberrad and Thomas Hill Easterfield.

When halogens were allowed to act on ethyl sodiocarboxyglutarate, no condensation occurred, but instead of ethyl carboxydiglutarate the haloid derivatives of the original ethyl carboxyglutarate were formed. The reaction may be thus represented:

$$C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CNa(CO_2\cdot C_2H_5)_2 + I_2 = NaI + C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CI(CO_2\cdot C_2H_5)_2$$

The products proved to be identical with the compounds subsequently obtained by the direct halogenation of ethyl carboxyglutarate.

82. "Studies on optically active carbimides. Part I." By Allen Neville and Robert Howson Pickard.

The authors have investigated (i) the preparation of some optically active carbimides, (ii) the use of such compounds for the resolution of synthetical alcohols and amines containing asymmetric carbon atoms, (iii) the measurement of the velocity of reaction between such compounds and various alcohols and amines with the object of contrasting the influence of (1) the constitution of the alcohols and amines, (2) the temperature, (3) the solvents, and (4) various catalytic agents on the velocity of such reactions.

The compounds described were: bornylcarbimide (compare Forster and Attwell, this vol., p. 91), *ethyl bornylcarbamate* and *dibornylcarbamide*, l-*menthylcarbimide*, *methyl ethyl* and *propyl* l-*menthylcarbamates*, and *di*-l-*menthylcarbamide*.

83. "The comparison of the rotation values of methyl, ethyl, and *n*-propyl tartrates at different temperatures." By Thomas Stewart Patterson.

Methyl tartrate was first shown to be capable of existence in a solid form melting at 61·5°.

Data for the variation of rotation with change of temperature of methyl, ethyl, and propyl tartrates were given. Comparisons of the rotation values of these substances at identical temperatures

were shown to be of little value, especially at low temperatures. Since, however, the rotation of methyl tartrate vanishes at 0°, that of ethyl tartrate probably at $-34°$, and that of propyl tartrate probably at $-60°$, it may be assumed that the three substances are in corresponding optical conditions at these temperatures, and, in general, methyl tartrate at T°, ethyl tartrate at $(T-34°)$, and propyl tartrate at $(T-60°)$ will also be in corresponding conditions as regards rotation. It is shown that comparisons of rotation effected at corresponding temperatures are much more satisfactory than those obtained for identical temperatures, and that if the rotations are taken at corresponding temperatures, the increment of $2CH_2$ in passing from methyl to ethyl tartrate rather more than doubles the rotation, whilst the next increment of $2CH_2$ in passing to propyl tartrate increases the rotation to 1·41 times that of ethyl tartrate. The rotation of propyl tartrate is therefore almost three times that of methyl tartrate. These results hold within wide limits of temperature.

84. **"Note on the action of hydrogen sulphide on formaldehyde and acetaldehyde solutions." By Julien Drugman and William Ernest Stockings.**

Although the conditions under which various thio-derivatives are formed when hydrogen sulphide reacts with aqueous solutions of formaldehyde and acetaldehyde respectively have been thoroughly investigated by Hofmann (*Ber.*, 1868, **1**, 176; 1869, **2**, 152; 1870, **3**, 584), Pinner (*Ber.*, 1871, **4**, 257), Klinger (*Ber.*, 1876, **9**, 1894; 1877, 10, 1879; 1878, 11, 1023), Baumann and Fromm (*Ber.*, 1889, **22**, 2600; 1890, **23**, 69; 1891, **24**, 1434, 1457) and others, it is not generally known that provided hydrochloric acid or other strong mineral acid is absent, the reaction affords a sure means of detecting formaldehyde, even in the presence of acetaldehyde or other higher fatty aldehydes.

(1) When a dilute aqueous solution of formaldehyde is saturated with hydrogen sulphide in the absence of hydrochloric acid, and the test-tube set aside in a warm place (30—50°), no visible change occurs for about 3 or 4 hours, but afterwards a white, amorphous, flocculent precipitate is gradually deposited. This substance, when dried in a desiccator over sulphuric acid, melts, with decomposition, between 85° and 110°.

This characteristic thio-derivative is precipitated from formaldehyde solution by hydrogen sulphide even in the presence of acetaldehyde, methyl and ethyl alcohols, acetone, or acetic acid; the melting point of the product formed in presence of acetone or acetic acid is fairly

definite, namely, 98—103°, and sometimes quite sharp at 98°. According to Baumann (*loc. cit.*), the compound has the composition $3(CH_2S),CH_2O$; it is distinguished from the odourless, crystalline trithioformaldehyde, $(CH_2S)_3$, both by its lower melting point and strong odour. The presence of even 0·1 per cent. of formaldehyde in aqueous solution may be easily detected by means of this reaction.

(2) The crystalline trithioformaldehyde, $(CH_2S)_3$, first prepared by Girard by the reduction of carbon disulphide by means of nascent hydrogen (*Compt. rend.*, 1870, 70, 623), and afterwards fully investigated by Hofmann (*loc. cit.*), results when hydrogen sulphide acts on a solution of formaldehyde previously strongly acidified with hydrochloric acid. The crude product melts indefinitely between 180° and 205°, but it crystallises from hot acetone in white needles which melt at 216°.

(3) When a solution of acetaldehyde is saturated with hydrogen sulphide in the absence of hydrochloric acid or other strong mineral acid, and the test-tube set aside in a warm place, the liquid soon assumes a milky appearance, owing to the separation of minute, oily particles, which gradually collect in drops on the bottom and sides of the test-tube, leaving the rest of the liquid perfectly clear and translucent. No solid product is ever obtained under these conditions, a circumstance which at once differentiates the behaviour of acetaldehyde from that of formaldehyde.

(4) Several distinct crystalline thio-derivatives can be obtained by the action of hydrogen sulphide on aqueous or alcoholic solutions of acetaldehyde previously acidified with hydrochloric acid. Among these may be mentioned the volatile bimolecular compound,

$$CH_3\cdot CH\langle{}^{S}_{O}\rangle CH\cdot CH_3,$$

which melts at 61°, and the *α*-, *β*-, and *γ-trithioacetaldehydes*, $(C_2H_4S)_3$, which melt at 101°, 125—126°, and 76° respectively. The character of the products and the relative proportions in which they are formed depend entirely on the experimental conditions. When, however, a dilute (1 to 20 per cent.) aqueous solution of acetaldehyde, acidified with about one-fifth of its volume of strong hydrochloric acid, is saturated with hydrogen sulphide and the test-tube set aside in a beaker over a water-bath kept at 50—60°, a very characteristic and striking phenomenon is observed. At the outset, the liquid assumes the milky appearance described under (3), then gradually becomes clear, and finally, after some hours, a volatile thio-compound sublimes on to the cooler portions of the tube in the form of long, glistening needles, which, after crystallisation from acetone or dilute alcohol, melt at 75—78°. The sublimate is not, however, formed if the original solution contains formaldehyde as well as acetaldehyde. In this case, the

mixed thio-compounds separate together from the liquid as a crystalline precipitate. Moreover, if the original solution contains a volatile solvent, such as acetone or alcohol, the sublimate will only appear after the solvent in question has nearly all evaporated.

(5) Aqueous solutions of propaldehyde or *iso*butaldehyde saturated with hydrogen sulphide, without any addition of hydrochloric acid and set aside in a warm place, exhibit a similar behaviour to that of acetaldehyde solutions under the same conditions. The oily thio-compounds obtained soon fall to the bottom of the test-tube, leaving the supernatant liquid quite clear. The presence of hydrochloric acid does not materially alter the character of the appearances observed, except in the case of *iso*butaldehyde when, after a very long time, a slight crystalline sublimate may be formed.

85. "**The viscosity of liquid mixtures.**" **By Albert Ernest Dunstan.**

The following conclusions were drawn from the author's investigation on the viscosity of liquid mixtures:

(1) Aqueous solutions give abnormal results. This is true for all known cases, which, however, are always solutions of two associated liquids, as, for example, alcohol and water.

(2) Wherever chemical affinity is existent to any marked extent in the two liquids of a mixture, abnormal results occur. In many such cases, definite complexes have been isolated.

(3) Wherever marked abnormalities present themselves, it is noted that they do so near points of definite molecular composition, but these points of abnormality are not constant, and shift with change of temperature. At a sufficiently high temperature, they would probably vanish, as then no formation of complexes would be possible.

(4) When points of minima are obtained in the viscosity curve, it is difficult to say whether association or dissociation is proceeding. It certainly seems due to some change in molecular aggregation.

(5) Substances containing the hydroxyl group (and associated) have a higher viscosity, as a rule, than monomolecular substances. Hence the rise of viscosity in the case of alcohol—water is probably due to the formation of complexes.

A further examination of hydroxylic substances is in progress.

86. "**The conversion of *iso*propyl alcohol into *iso*propyl ether by sulphuric acid.**" **By Frank Southerden.**

In the course of some experiments on etherification by the agency of small quantities of sulphuric acid at high temperatures, it has been

found possible to prepare *iso*propyl ether. The yield is very poor, and therefore without improved conditions the method cannot be said to compete with that involving the use of alkyl iodide (Erlenmeyer, *Annalen*, 1863, **126**, 305), but it is interesting as an example of the production of a secondary ether from its alcohol.

Previous observers have obtained only propylene in this reaction. When, however, 3 c.c. of H_2SO_4 were employed for 100 c.c. of *iso*propyl alcohol (b. p. 81—83°), and the mixture heated for 6—12 hours at 150—160°, the ether was formed along with propylene. After removal of the unchanged alcohol by prolonged treatment with sodium, the whole distilled at 70—70·5° (uncorr.). Zander (*Annalen*, 1882, **214**, 164) gives 68·5—69° as the boiling point of the ether. The *iso*propyl ether has an intense odour resembling peppermint; bromine in carbon tetrachloride solution is not decolorised by it. Two vapour density determinations obtained by Victor Meyer's method gave 51·3 and 51·4 whereas the calculated value for $(C_3H_7)_2O$ is 51.

ADDITIONS TO THE LIBRARY.

Donations.

British Fire Prevention Committee. First International Fire Prevention Congress. . . Report 1903. pp. 207. ill. London 1903. From the Committee.

Carnot, Adolphe. Traité d'analyse des substances minérales. Tome 2. Métalloïdes. pp. 821. Paris 1904. From the Publishers.

Clowes, Frank, and Houston, A. C. The experimental bacterial treatment of London sewage, being an account of the experiments carried out by the London County Council between the years 1892 and 1903. pp. xii + 242. ill. London 1904. From Professor Frank Clowes.

Engelhardt, Viktor. The electrolysis of water, processes and applications. Authorised English translation by Joseph W. Richards. pp. 140. ill. Easton, Pa. 1904. From the Publishers.

Gadd, H. Wippell. Drugs, their production, preparation, and properties. pp. xi + 180. London 1904. From the Author.

Günther, R. T. A history of the Daubeny Laboratory, Magdalen College, Oxford. To which is appended a list of the Writings of Dr. Daubeny, and a Register of the Names of Persons who have attended

the Chemical Lectures of Dr. Daubeny from 1862 to 1867, as well as of those who have received instruction in the Laboratory up the present time. With some additional papers. pp. vii + 137 + clxiv. ill. London 1904. From the Author.

Hittorf, J. W., and Plücker, J. On the spectra of ignited gases and vapours, with especial regard to the different spectra of the same elementary gaseous substance. pp. 39. ill. 1904. From Professor W. A. Tilden, F.R.S.

Merrill, Elmer D. A dictionary of the plant names of the Philippine Islands. pp. 193. Manila 1903. From the Author.

Muir, M. M. Pattison. The elements of chemistry. pp. 554. ill. London 1904. From the Author.

Pictet, Amé. The vegetable alkaloids, with particular reference to their chemical constitution. From the second French edition, rendered into English, revised and enlarged by H. C. Biddle. pp. 505. New York 1904. From the Publishers.

Schmatolla, Otto. Neue Entdeckungen aus dem Gebiete der Chemie und Physik. Die unbegrenzte Teilbarkeit der Masse, der Aufbau der Körper. pp. 84. Berlin 1904. From the Author.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome I., 1, and III., 1. pp. ix + 528, 672. ill. Paris 1904. From Professor H. Moissan.

Pamphlets.

Brough, Bennett H. Cantor lectures on the mining of non-metallic minerals, delivered before the Society of Arts, November and December, 1903. pp. 48. ill. London 1904.

Bürgi, R. T. Der Elektronäther. Beiträge zu einer Neuen Theorie der Elektrizität und Chemie. pp. 47. Berlin 1904.

Dymond, T. S., and Bull, B. W. Variation in the milk of a dairy herd during the summer months. Chelmsford, Essex 1904.

Kunz, George F., and Baskerville, Charles. The action of radium, actinium, Roentgen rays, and ultra-violet light on minerals and gems. (From *Science*, N.S., 18.)

Long, J. H. The electrical conductivity of urine in relation to its chemical composition. Part II. The conductivity of mixed solutions. (From the *J. Amer. Chem. Soc.*, 26.)

Richards, Theodore William, and Stull, Wilfred Newsome. New method for determining compressibility. pp. 45. ill. Washington 1903.

Senier, Alfred. On acridines. Abstract of a paper read before the British Association, Southport meeting, 1903. (From the *Chemical News*, 88.)

ERRATA.

PROC., 1904, Vol. 20.

Page.	Line.	
88	14	*for* "$[\alpha]_D$" *read* "α_D"
88	20	*delete* "veratric acid."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on **Wednesday**, May 18th, 1904, at **5.30** p.m., the following papers will be communicated:

"Action of nitrosyl chloride on pinene." By W. A. Tilden.

"The electrolytic estimation of minute quantities of arsenic." By H. J. S. Sand and J. E. Hackford.

"The decomposition of the alkylureas. A preliminary note." By C. E. Fawsitt.

"The action of sodium methoxide and its homologues on benzophenone chloride and benzylidene chloride. Part II." By J. E. Mackenzie and A. F. Joseph.

"The formation of periodides in nitrobenzene solution. II. Periodides of the alkali and alkaline earth metals." By H. M. Dawson and Miss E. E. Goodson.

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Issued 31/5/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 281.

Wednesday, May 18th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Before entering on the ordinary business of the meeting, the PRESIDENT said he thought it would be consonant with the wishes of the Fellows if he gave expression to the deep feeling of regret with which they had all received the news of the death of one of the most eminent of their past Presidents, Professor Williamson. A man of philosophic mind and great intellectual activity, he had been led in the later years of his life to abandon research in connection with chemistry in favour of other pursuits. Hence it was difficult for chemists of the present generation to realise how great had been the influence exercised by his experimental researches and his writings on the progress of theoretical chemistry forty years ago. Williamson served the Society during many years on the Council, as vice-President, and for two separate periods as President. The Society had, of course, been represented at the funeral, at which many past and present officers of the Society—including himself and the Treasurer—had assembled, and a resolution of condolence with the family had that day been passed at the meeting of the Council.

Messrs. N. J. Bluman, J. C. Evans, G. Pinchbeck, and M. W. Stevens were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Frank Harold Lowe, B.Sc., 59A, Fulham Park Gardens, S.W.
Henry Stanley Shelton, 4, Larden Road, Acton Vale, W.
Herbert Jenkins, 52, Criffel Avenue, Streatham Hill, S.W.
Rudolf Lessing, Ph.D., 31, Brunswick Square, W.C.
Robert Rodger, 54, Rostrevor Road, S.W.
William Edward Oakden, 2, Gledhow Terrace, South Kensington, S.W.
Charles John Sawer, 6, Cleveland Road, Brighton.

A ballot for the election of Honorary and Foreign members was held, and the following were subsequently declared duly elected:

Prof. Antoine Henri Becquerel.
Prof. Cornelis Adriaan Lobry de Bruyn.
Prof. Frank Wigglesworth Clarke.
Madame Marie Curie.
Prof. Carl Theodor Liebermann.
Prof. Edward Williams Morley.

In reply to Prof. Divers, the PRESIDENT stated that Counsel's opinion had been taken on the question whether women were eligible for election as ordinary Fellows of the Society under the present Charter, and that the opinion was adverse.

***87. "The action of nitrosyl chloride on pinene." By William Augustus Tilden.**

Pinene nitrosochloride having been shown by von Baeyer to have the double formula $(C_{10}H_{16}\cdot NOCl)_2$, it occurred to the author that the unsatisfactory yield of this compound by the usual processes might be improved by using a mixture of equal quantities of *d*- and *l*-pinenes which is optically inactive. Whereas previously the yield of nitrosochloride from ordinary *d*-pinene was about 32 per cent. of the pinene, and the product from the more highly rotatory pinene obtained from French turpentine was still less, the employment of a mixture prepared so as to be optically inactive gives 55 per cent.

The melting point of pure pinene nitrosochloride is not 103°, as originally given, but 115° (*circa*). Attempts to resolve pinylamine into two optically active bases proved unsuccessful.

For the regeneration of pinene from the nitrosochloride, methylaniline is recommended in preference to aniline, as there is no violent action and the yield of pinene is greater.

Finally, it is shown that when the nitrosochloride is converted into nitrosocyanide (Tilden and Burrows, *Proc.*, 1902, **18**, 161) or into

the piperidylnitrolamine, the compound becomes monomolecular at the same time that the nitroso-group assumes the *iso*nitroso- or oxime structure.

Discussion.

Professor Meldola suggested that the base produced by the action of dimethylaniline on pinene nitrosochloride might be Bindschedler's green resulting from the secondary interaction between nitrosodimethylaniline and the excess of dimethylaniline present under the conditions of the experiment (*Ber.*, 1883, **16**, 864).

*88. "The electrolytic estimation of minute quantities of arsenic." By Henry Julius Salmon Sand and John Edward Hackford.

A high supertension of the cathode is requisite for the reduction of arsenic acid to metallic arsenic, the reaction being most readily effected in the presence of metals having this property, such as lead or zinc and probably also mercury. Platinum, having a low supertension, is quite inefficient.

The production of arsenic trihydride from arsenites is accomplished more readily by platinum cathodes than by those of copper, which have a much higher supertension. In this case, mercury, with an extremely high supertension, is quite unsuitable. A certain amount of supertension, however, appears to be necessary, for platinised platinum with no supertension is inefficient.

The authors recommend the use of lead electrodes for the estimation of minute quantities of arsenic as their application causes a simplification of previous methods. Errors which may arise in the electrolytic methods owing to the presence of foreign metals can be rectified by the addition of lead acetate or zinc sulphate to the electrolyte except when the foreign metal is mercury. When lead and zinc cathodes are used, the smallest amount of arsenic which can be detected in alkaline solutions of arsenates and arsenites is about thirty times as great as in acid solution, but platinum cathodes are quite unsuitable.

Discussion.

Dr. F. M. Perkin remarked that although the electrolytic apparatus gave good results even with very minute quantities of arsenic, it was, however, a great advantage to have an apparatus in which lead was employed for the cathode instead of the very expensive platinum. The fact that a mercury cathode did not give good results, although there was considerable over-voltage, was due to the formation

of an arsenic amalgam, which then escaped the reducing action of the hydrogen. An aluminium cathode is suitable for dilute sulphuric acid solutions, because in this case there is considerable over-voltage and the metal is very slightly attacked, and is, moreover, free from arsenic.

Had nickel electrodes been tried in an alkaline solution?

The only drawback to the electrolytic method for detecting arsenic is the trouble of preparing the mirrors, especially when special standards are made for each substance tested.

Dr. STEVENSON asked what was the authors' evidence that the lead of commerce can be obtained free from arsenic.

Mr. SAND, in reply, said the electrolytic experiments in alkaline solutions had not been found satisfactory, and had, moreover, not been tried in the case of nickel.

The preparation of mirrors for each kind of material examined was not absolutely necessary, but, nevertheless, this precaution rendered the comparisons more certain.

Several grams of commercial lead had been examined for arsenic with a negative result. The lead most frequently used for cathodes was purest assay lead, whereas pure commercial lead was employed for anodes. New electrodes often contain a small amount of arsenic on the surface, but in all cases they were tested by blank experiments.

***89. "The action of sodium methoxide and its homologues on benzophenone chloride and benzylidene chloride. Part II." By John Edwin Mackenzie and Alfred Francis Joseph.**

The authors have found that benzhydrol is formed in the preparation of di*iso*propyloxy-, di*iso*butyloxy-, and di*iso*amyloxy-diphenylmethanes by the action of the respective sodium alkyloxides on benzophenone chloride (compare Trans., 1901, 79, 1204). It is also shown that dibenzoxydiphenylmethane, like its homologues, readily splits up into benzophenone and dibenzyl oxide.

The anhydride of phenyldi-β-hydroxynaphthylmethane has been obtained by the action of benzylidene chloride on β-naphthol, and found to agree in properties with the substance prepared by Claisen (*Annalen*, 1887, 237, 261) from benzaldehyde and β-naphthol. This product was also obtained when the reaction was carried out in xylene solution and when sodium naphthoxide was used instead of naphthol. Claisen's dihydroxy-compound could not be isolated.

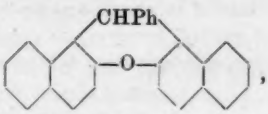
Nitration experiments on the anhydride led to the formation of substances containing from two to six nitro-groups.

When treated with fuming sulphuric acid, the anhydride yielded a

β-naphtholdisulphonic acid, but concentrated sulphuric acid gave rise to a product dissolving in water to a bright red solution, the colour of which was destroyed by alkalis and restored by acids.

Discussion.

Professor Meldola said that in his opinion the constitution of Claisen's compound might be more correctly represented by the following formula:



as it was more in harmony with the general properties of β-naphthol that the α-ortho-position, and not the second β-position, should be first attacked.

Dr. Hewitt stated that the hydroxylic compound,

$$C_6H_5\cdot CH(C_{10}H_6\cdot OH)_2,$$

is easily produced by condensing benzaldehyde and β-naphthol in cold acetic acid solution by the aid of hydrochloric acid, and from this the anhydro-substance can be obtained in good yield by heating with acetic acid in sealed tubes.

The coloration observed on dissolving the anhydride in strong sulphuric acid is probably due to oxidation and formation of a carboxonium salt similar to those already studied by Werner, Fosse, and himself.

Dr. Mackenzie replied that at present he had no decided views in favour of the 2 : 3-structure of the anhydride molecule as against the 1 : 2-configuration; he had not yet obtained any substitution products in support of either of these constitutions.

*90. "The bromination of phenolic compounds." By John Theodore Hewitt, James Kenner, and Harry Silk.

When one molecular proportion of bromine acts on phenol, the character and proportions of the products obtained vary with the conditions under which the reaction is carried out. In aqueous solution, the phenol is apparently not all brominated, some of the bromine being used in forming higher substitution products. Absence of water and presence of a strong mineral acid favours the formation of *p*-bromophenol; the quantity of the para-compound diminishes, however, if sodium acetate is added to a glacial acetic acid solution of phenol before bromination, but is slightly increased by the addition of concentrated sulphuric acid.

If more than one molecular proportion of bromine is added to a solution of phenol in concentrated sulphuric and glacial acetic acids, the second molecule of bromine is utilised very slowly, the sulphuric acid hindering substitution in the ortho-position, but by brominating phenol in excess of 73 per cent. sulphuric acid, the halogen rapidly enters into reaction, and a nearly quantitative yield of 2 : 4-dibromophenol is obtained, apparently without any admixture of tribromophenol.

5-Bromosalicylic acid can be conveniently prepared by brominating salicylic acid in a mixture of sulphuric and acetic acids.

4-Bromo-α-naphthol cannot, however, be obtained from α-naphthol under similar conditions, dibromination taking place.

DISCUSSION.

Professor MELDOLA pointed out that in the case of the naphthols it was well known that the first action of bromine is to produce additive products from which hydrogen bromide is expelled by heat. With reference to the influence of temperature as determining the formation of *o*-bromophenol instead of the para-compound, he called attention to Merck's German patent (No. 76597, of 1893), in which it is claimed that by chlorinating or brominating phenol at 150—180° the corresponding halogenated ortho-derivative is produced.

91. "The decomposition of the alkylureas. A preliminary note." By Charles Edward Fawsitt.

The author has already shown (*Zeit. physikal. Chem.*, 1902, **41**, 601) that the decomposition of urea by acids is not a case of ordinary hydrolysis, but is the result of a secondary decomposition, following an isomeric transformation into ammonium cyanate. An investigation of the velocity of decomposition of the alkylureas with acids by similar methods shows an exact parallel with the case of urea. The hydrolysis is indirect, and is effected as a secondary reaction of the acid with the alkylammonium cyanate. Methylurea is decomposed more slowly than urea, but dimethylurea much more rapidly.

***92. "The formation of periodides in nitrobenzene solution. Part II. Periodides of the alkali and alkaline earth metals." By Harry Medforth Dawson and Ethel Elizabeth Goodson.**

Previous experiments relating to the nature of the periodides which are formed in nitrobenzene solutions containing iodine and potassium iodide (Dawson and Gawler, Trans., 1902, **81**, 524) have been extended to the iodides of the other alkali metals, and to those of the

alkaline earth metals, and ammonium and substituted ammoniums. In general, these iodides have properties similar to those of the potassium derivative, and the experimental data indicate that enneaiodides of the type $M'I_9$ or $M''I_{18}$, which are the essential components of such solutions when saturated with iodine, probably represent the highest limiting type of periodide, for the solvent used in these experiments appears to be specially suited to the formation of such periodides, and saturation of the solution with iodine favours the formation of the most complex product.

In the case of certain substituted ammonium radicles, enneaiodides have been already isolated and the analogous behaviour of the alkali and alkaline earth metals indicates the possibility of preparing enneaiodides of these metals under favourable conditions.

Periodides are also formed by the bromides of the alkali metals in nitrobenzene solution and to a small extent by the chlorides.

Compounds of lithium iodide with nitrobenzene and *o*-nitrotoluene, and of sodium penta-iodide with nitrobenzene have been isolated.

93. "The action of ozone on ethane. Preliminary note." By William Arthur Bone and Julien Drugman.

The authors have obtained ethyl alcohol by the interaction of ethane and ozone at 100°. Two experiments have been carried out as follows: ethane and ozonised air (O_3 = about $2\frac{1}{2}$ per cent.) were separately led into the top of a vertical, wide glass tube, about 18 inches long, packed with glass beads and heated by a steam jacket. The proportions of the gases were so regulated that the ethane was always present in large excess, under which conditions the ozone entirely disappeared as the mixture slowly descended the tube. The gases were then drawn through a series of cooled glass worms containing water for the absorption of soluble intermediate products. Each experiment extended over 3 or 4 days, during which about 5 litres of ethane and 13 to 15 litres of the ozonised air passed through the apparatus. Subsequent examination of the liquid from the coolers showed that it contained ethyl alcohol, acetaldehyde, and traces of formaldehyde. The presence of ethyl alcohol was proved by first oxidising the aldehydes by means of an excess of an ammoniacal silver solution at the ordinary temperature (1 hour), then acidifying the liquid with dilute sulphuric acid and submitting it to distillation in steam. The distillate in each case at once gave the iodoform reaction; the precipitate was composed of microscopic crystals, which slowly formed the characteristic star-like aggregates. As a precaution, the absence of acetaldehyde from the distillate was proved by the negative result obtained with Schiff's

reagent. An examination of the gaseous products showed that they did not contain acetylene, ethylene, or free hydrogen.

There can be but little doubt, therefore, that ethyl alcohol is the primary product in the slow combustion of ethane. At temperatures where ethane begins to react with oxygen with appreciable velocity, the alcohol is oxidised so many times faster that it is practically impossible actually to detect its formation (compare Bone and Stockings, this vol., p. 106). The authors propose to continue the experiments, and to extend them to ethylene, acetylene, and other typical hydrocarbons.

94. "Caproylthiocarbimide." By Augustus Edward Dixon.

Caproyl chloride, dissolved in benzene, interacts spontaneously with finely-powdered ammonium thiocyanate, yielding *caproylthiocarbimide*, $C_5H_{11}\cdot CO\cdot NCS$; b. p. 108°/23 mm.; sp. gr. = 1·0165 at 18°/15°. This liquid is slowly hydrolysed by boiling water into caproic and thiocyanic acids; when heated with an alkaline lead salt, it yields metallic sulphide, together with thiocyanate, and is readily desulphurised by ammoniacal silver nitrate. If brought into contact with primary and secondary amines, direct union occurs, with formation of the corresponding thiocarbamides.

ab-*Caproylphenylthiocarbamide*, $C_5H_{11}\cdot CO\cdot NH\cdot CS\cdot NHPh$, separates from alcohol in felted masses of needles, melting at 77—78° without decomposition; when dissolved in hot dilute caustic alkali, the caproyl group is removed, leaving phenylthiourea.

ab-*Caproyl-o-tolylthiocarbamide* melts at 97—98° and generally resembles the phenyl compound. When treated in hot alcoholic solution with the calculated quantity of silver nitrate, it yields the corresponding ab-*caproyl-o-tolylurea* (m. p. 99—100°). ab-*Caproyl-p-tolythiocarbamide* (m. p. 90—91°), when treated with silver nitrate, yields *caproyl-p-tolylurea*, melting at 131—132° (corr.).

n-*Caproylphenylbenzylthiourea*, $C_5H_{11}\cdot CO\cdot N{:}C(SH)\cdot NBzPh$, was obtained from benzylaniline and the thiocarbimide; it separated from alcohol in vitreous prisms melting at 77—78°, and was not affected by boiling with neutral or ammoniacal silver nitrate; when boiled with caustic alkali, the caproyl group is eliminated, leaving a residue which can be desulphurised by an alkaline solution of lead.

Since, by interaction with water, the parent oil gives thiocyanic acid instead of carbon oxysulphide, its behaviour in these circumstances must be accounted that of a thiocyanate; on the other hand, the power to combine with nitrogenous bases, thereby yielding substituted thiocarbamides, places it among the *iso*thiocyanates. This

dual capacity is in accordance with the view developed in earlier papers by the author (*Trans.*, 1901, **79**, 542; this vol. p. 350), that a variety of tautomerism subsists amongst the thiocyanates of electronegative radicles, the characteristic sulphuretted group of which may act either as ·SCN or ·NCS. Moreover, in certain cases, both forms appear to be simultaneously active (Doran, *Proc.*, 1904, **20**, 20), the preponderance of one or other depending almost entirely on the temperature at which interaction is caused to take place.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Caro, N., Ludwig, A., und Vogel, J. H. Handbuch für Acetylen in technischer und wissenschaftlicher Hinsicht. Herausgegeben von J. H. Vogel. pp. xiv + 880. ill. Braunschweig 1904.

Noelting, E., und Lehne, A. Anilinschwarz und seine Anwendung in Färberei und Zeugdruck. Zweite Auflage. pp. 178. ill. Berlin 1904.

Ostwald, Wilhelm. Grundlinien der anorganischen Chemie. Zweite Auflage. pp. xx + 808. ill. Leipzig 1904.

Ostwald, Wilhelm. Malerbriefe, Beiträge zur Theorie und Praxis der Malerei. pp. viii + 165. Leipzig 1904.

Spaeth, Eduard. Die chemische und mikroskopische Untersuchung des Harnes. pp. xx + 532. ill. Leipzig 1903.

III. *Pamphlets.*

Beach, S. A., Clark, V. A., and Taylor, O. M. Spray mixtures and spray machinery. (New York Agric. Exper. Station. Bulletin No. 243.)

Fairley, Thomas. The uses of lime on land. (From the *Annual Report, Yorkshire Agric. Soc.*, 1904.)

Grindley, H. S., and Mojonnier, Timothy. Experiments on losses in cooking meat. (U. S. Dept. of Agriculture, Office of Experiment Stations. Bulletin No. 141.) Washington 1904.

New York Agricultural Experimental Station. Directors' Report for 1903. (Bulletin No. 244.)

Parrot, P. J., Beach, S. A., and Woodworth, H. C. The lime-sulphur-soda wash for orchard treatment. (New York Agric. Exper. Station. Bulletin No. 247.)

Sherman, Penoyer, L. The gutta-percha and rubber of the Philippine Islands. Manila 1903.

Sodeau, William H. The decomposition of chlorates. (From the *Proc. Univ. of Durham Phil. Soc.*, 2, pt. 3.)

——The estimation of unburnt products in chimney gases by means of a modified Orsat apparatus. (From the *Chemical News*, 89.)

Taylor, O. M., and Clark, V. A. An experiment in shading strawberries. (New York Agric. Exper. Station. Bulletin No. 246.)

Van Slyke, L. L., and Hart, E. B. Chemical changes in the souring of milk and their relations to cottage cheese. (New York Agric. Exper. Station. Bulletin No. 245.)

Wheeler, W. P. The importance of mineral matter and the value of grit for chicks. (New York Agric. Exper. Station. Bulletin No. 242.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on **Thursday**, June 2nd, 1904, at 8 p.m., the following papers will be communicated:

"*iso*Nitrosocamphor." By M. O. Forster.

"Imino-ethers and allied compounds corresponding with the substituted oxamic esters." By G. D. Lander.

"The action of heat on α-hydroxycarboxylic acids. Part I. α-Hydroxystearic acid." By H. R. Le Sueur.

"The basic properties of oxygen. Additive derivatives of the halogen acids and organic compounds and the higher valencies of oxygen. Asymmetric oxygen." By E. H. Archibald and D. McIntosh.

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Issued 11/6/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 282.

Thursday, June 2nd, 1904. Dr. W. H. PERKIN, F.R.S., Vice-President, in the Chair.

Messrs. T. L. D. Porter and C. Smith were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William Herbert Dalton, 85, Hayter Road, Brixton Hill, S.W.

John Evans, 67, Surrey Street, Sheffield.

Archie Willoughby Henzell, Witton Hall Industrial School, Birmingham.

Arnold Bertram Tonkin, Durban, Natal.

Henry Bridges Weeks, The Retreat, Infield Park, Barrow-in-Furness.

Of the following papers, those marked * were read:

*95. **"Imino-ethers and allied compounds corresponding with the substituted oxamic esters."** By George Druce Lander.

When piperidine and phenylhydrazine condense in anhydrous media with methyl dichloro-oxalate, the dipiperidide,

$$CO_2Me\cdot C(C_5NH_{10})_2\cdot OMe,$$

and the imino-compound, $CO_2Me{\cdot}C(OMe){:}N{\cdot}NHPh$ (m. p. 123—124°), result, as described by Anschütz and Stiepel (*Annalen*, 1899, **306**, 11). The latter substance gives the corresponding acid, which is unstable, yielding, on boiling with aqueous methyl alcohol, carbon dioxide, oxalic acid, and formazan.

With aniline and *p*-toluidine it was not found possible to isolate either the mixed ortho-compounds, $CO_2Me{\cdot}C(NHR)_2{\cdot}OMe$, or the imino-ethers, $CO_2Me{\cdot}C(:NR){\cdot}OMe$, of Anschütz and Stiepel. Diarylamidino-oxalic esters, $CO_2Me{\cdot}C(:NR){\cdot}NHR$, and small quantities of the corresponding amidinoamides were obtained in the cold, and also in boiling xylene solution, together with substituted oxamates and oxamides, substituted formamidines, carbon dioxide, and methyl chloride.

Semi-N-phenylimino-oxalic dimethyl ether, $CO_2MeC(:NPh){\cdot}OMe$, a liquid (b. p. 130—132°/12 mm.) prepared by methylating methyl oxanilate by means of silver oxide, resembles the diethyl analogue, (*Trans.*, 1901, **79**, 699). Dry ammonia was found to be without action in the cold on any of the oxalimino-ethers.

The following compounds were described: *methyl phenylmethyloxamate* (b. p. 170—175°/13 mm.); *semi*-N-p-*tolylimino-oxalic diethyl ether* (b. p. 160°/14 mm.); *methyl diphenylamidino-oxalate* (m. p. 65—66°), and the analogous *di*-p-*tolyl methyl ester* (m. p. 103°) and *ethyl ester* (m. p. 98—100°).

The *diphenyl-* and *di*-p-*tolyl-amido-oxalic acids* lose carbon dioxide on heating, and change into substituted formamidines,

$$CO_2H{\cdot}C(:NR){\cdot}NHR \longrightarrow CO_2 + HC(:NR){\cdot}NHR,$$

whilst the di-*p*-tolylamidino-ester, on heating, evolves carbon dioxide and yields *di*-p-*tolylmethylformamidine*. The hydrochlorides of the amidino-esters decompose on fusion, giving rise to methyl chloride, carbon dioxide, and formamidines.

Methyl iodide and the di-*p*-tolylamidino-ester give the *methyl ester*, $CO_2Me{\cdot}C(:NC_7H_7){\cdot}NMe{\cdot}C_7H_7$ (m. p. 91—92°), the corresponding *acid* decomposing at 80—81° into carbon dioxide and the foregoing di-*p*-tolylmethylformamidine.

***96. "The action of heat on α-hydroxycarboxylic acids. Part I. α-Hydroxystearic acid." By Henry Rondel Le Sueur.**

The investigation of the action of heat on α-hydroxystearic acid, briefly described in a preliminary note (*Proc.*, 1904, **19**, 14), has now been completed, and in view of the fact that Blaise (*Compt. rend.*, 1904, **138**, 697) has recently published an account of work of a

similar nature, it appears desirable to set forth the results of this investigation.

Margaric aldehyde, $C_{16}H_{33}\cdot CHO$, produced on heating α-hydroxystearic acid, crystallises in needles and melts at 36°; its *oxime* and *semicarbazone* melt at 89·5° and 107—108° respectively. With hydrogen cyanide, it forms *α-hydroxyheptadecyl cyanide* (m. p. 61·5—62·5°), which, on partial hydrolysis, gives *α-hydroxystearamide* melting at 148—149°, and, on complete hydrolysis, α-hydroxystearic acid.

Margaric acid, obtained by oxidation of the above aldehyde with potassium permanganate, melts at 60—61°; its *methyl* and *ethyl* esters melt at 29° and 28° respectively. *α-Bromomargaric acid* crystallises from dilute acetic acid in glistening plates (m. p. 52·5°).

Discussion.

Dr. Lewkowitsch pointed out with regard to the α- and β-hydroxystearic acids obtained from oleic and *iso*oleic acids respectively that the α-compound was not identical with the α-acid described by the author since, on oxidation with chromic acid, it yielded sebacic and ketostearic acids and was probably a κ-acid. It would be of interest to know whether the author's margaric acid was identical with Krafft's margaric acid or with daturic acid; the latter might now be regarded as an acid which could be somewhat easily obtained, since it had been found in lard as the mixed glyceride, daturodistearin.

Dr. Le Sueur, in reply, said that the acid which he had described was probably identical with Krafft's margaric acid, as the two substances melted at practically the same temperature; but, as Krafft had not prepared any characteristic derivatives from this acid, he could not state definitely that they were one and the same substance. These remarks also applied to daturic acid, which melts at 55°.

*97. "Ionisation and chemical combination." By James Wallace Walker.

The assumption that all chemical reaction takes place between pre-existing ions is unsatisfactory in that it is incapable of experimental demonstration. In many reactions, the formation of intermediate compounds points to the conclusion that such changes take place in several stages. Some of these compounds can only exist in virtue of the higher valencies possessed by their constituent atoms. Metathetic

reactions between the alkyl halides, which take place with great readiness in presence of aluminium chloride, are described and shown to be due to the formation of such compounds; they are accompanied by the production of ionised solutions, but in an analogous case, where the solution is also ionised, the corresponding reaction is excessively slow. Several series of observations point to the conclusion that ionisation is the result of chemical combination due to potential valency, and that reaction is not dependent in these cases on antecedent ionisation.

The ethers and the alkyl halides are shown to become quite good ionising media when employed in certain reactions in which they are themselves involved, although from their very low dielectric power they would not be expected to have this property. The variation of the molecular conductivity of some of these solutions with varying concentration shows very pronounced maxima and minima, which point to the formation of compounds with the solvent. These maxima and minima correspond in some instances with pronounced colour changes in the solutions. The conclusion is that, in general, combination through the operation of higher valencies precedes ionisation or any other manifestation of chemical change.

***98. "Ionisation and chemical combination in the liquefied halogen hydrides and hydrogen sulphide." By James Wallace Walker, Douglas McIntosh, and Ebenezer Henry Archibald.**

A large number of organic substances are shown to yield solutions which are good conductors of an electric current when dissolved in the liquefied halogen hydrides. Nearly all of those containing oxygen form conducting solutions in one or other of these media. In most of these instances, the ionisation can only take place after combination with the solvent. The importance of the existence of such compounds in depicting the mechanism of some of the fundamental reactions of organic chemistry is pointed out in the preceding communication. Hydrogen sulphide, although an exceedingly good solvent for nearly all classes of substances, yields only a few solutions which conduct at all and very few that conduct well. Almost all of these are, however, cases in which chemical combination between solvent and solute may be assumed.

*99. "Some compounds of aluminium chloride with organic substances containing oxygen." By James Wallace Walker and Arthur Spencer.

Compounds of aluminium chloride with ether, anisole, ethyl benzoate, methyl mandelate, ethyl oxalate, ethyl malonate, acetic acid, *o*-nitrotoluene, and *m*-dinitrobenzene have been prepared in order to determine whether there is a proportionality between the number of atoms of oxygen and the number of molecules of aluminium chloride which enter into combination.

In determining the depression of freezing point of aluminium chloride in *o*-nitrotoluene solution, it was found that this solvent has two crystalline forms, one melting at $-10°$ and the other at $-4{\cdot}25°$. The molecular weight of the salt apparently increases with increasing volume.

*100. "The constituents of chaulmoogra seeds." By Frederick Belding Power and Frank Howorth Gornall.

The seeds which afford the chaulmoogra oil of commerce are derived from *Taraktogenos Kurzii* (King), a native of Burmah, and not, as has until quite recently been assumed, from *Gynocardia odorata* (R.Br.). The oil has previously been examined by Moss (*Year-book of Pharmacy*, 1879, 523—533), Petit (*J. Pharm. Chim.*, 1892, 26, 445), and more recently by Schindelmeiser (*Ber. deutsch. pharm. Ges.*, 1904, 14, 164), but their results differ in many respects from those obtained by the present authors, which are as follows:

The seeds of *Taraktogenos Kurzii* (King), contain a hydrolytic enzyme, and also an unstable cyanogen compound, which reacts with the enzyme when the seeds are crushed, giving rise to hydrogen cyanide. Numerous attempts were made to isolate this compound, but without success. Further experiments will be made in this direction.

On expression, the seeds yielded 30·9 per cent. of a fatty oil, which had the following constants: m. p. 22—23°; sp. gr. 0·951 at 25° and 0·940 at 45°; $[\alpha]_D^{15°} + 52°$; acid value 23·9; saponification value 213; iodine value 103·2.

On hydrolysis, the fatty oil yielded glycerol, a very small amount of phytosterol, $C_{26}H_{43}{\cdot}OH$ (m. p. 132°), and a mixture of fatty acids (m. p. 44—45°; $[\alpha]_D + 52{\cdot}6°$ in chloroform; acid value 215; iodine value 103·2), which consisted chiefly of several homologous acids belonging to a series $C_nH_{2n-4}O_2$ containing a closed ring and one

ethylenic linking, no member of which has hitherto been isolated from a fatty oil. The highest of these homologues present, which was isolated in a pure condition, separates from most of the usual organic solvents in glistening leaflets (m. p. 68°; b. p. 247—248°/20 mm., $[\alpha]_D + 56°$), has the formula $C_{18}H_{32}O_2$, and is designated *chaulmoogric acid*. It combines with only two atomic proportions of bromine or iodine. Palmitic acid also was identified, and there is reason for assuming the presence of a near homologue or homologues of chaulmoogric acid, but belonging to the series having the general formula $C_nH_{2n-4}O_2$ with two ethylenic linkings. Undecylic acid and hydroxy-acids were proved to be absent, and an individual acid corresponding with hypogæic acid could not be isolated. The "gynocardic acid" of all previous investigators is believed to be a mixture of several substances.

The "press-cake" yielded, besides formic and acetic acids and a very small amount of volatile esters having the characteristic odour of the seeds, an appreciable amount of a neutral oily *substance*, $C_{18}H_{32}O_2$, (b. p. 214—215°/18 mm., sp. gr. 0·9066 at 16°/16°, $[\alpha]_D + 42·4°$), which is isomeric with chaulmoogric acid; this substance is being further investigated, as are also the seeds of *Gynocardia odorata* (R. Br.).

***101. "The constitution of chaulmoogric acid. Part I." By Frederick Belding Power and Frank Howorth Gornall.**

With the object of ultimately determining the constitution of *chaulmoogric acid*, $C_{18}H_{32}O_2$ (see preceding abstract), a number of its derivatives have been prepared and studied.

Methyl chaulmoograte, $C_{17}H_{31}\cdot CO_2Me$ (m. p. 22°, b. p. 227° corr./20 mm., sp. gr. 0·9119 at 25°/25°, $[\alpha]_D^{15°} + 50°$ in chloroform), was prepared by the interaction of the acid, methyl alcohol, and hydrogen chloride. *Ethyl chaulmoograte*, $C_{17}H_{31}\cdot CO_2Et$, a colourless oil (b. p. 230° corr./20 mm., sp. gr. 0·9079 at 15°/16°, $[\alpha]_D^{20°} + 50·7°$), was prepared in like manner. *Chaulmoogramide*, $C_{17}H_{31}\cdot CO\cdot NH_2$ (m. p. 106°, $[\alpha]_D^{20°} + 57·3°$ in chloroform), was obtained according to Aschan's method (*Ber.*, 1898, 31, 2344). *Bromodihydrochaulmoogric acid*, $C_{17}H_{32}Br\cdot CO_2H$ (m. p. 36—38°; optically inactive), is formed when chaulmoogric acid is treated with hydrogen bromide in glacial acetic acid.

Ethyl chaulmoograte absorbs two atomic proportions of bromine in the cold, forming *ethyl dibromodihydrochaulmoograte*, $C_{17}H_{31}Br_2\cdot CO_2Et$, which is an oil.

When chaulmoogric acid is treated with sodium in boiling amyl

alcohol, the ethylenic linking is not resolved, but there were obtained, after fractional distillation of the product, *chaulmoogryl alcohol*, $C_{18}H_{33}\cdot OH$ (m. p. 36°, $[\alpha]_D$ +58·4°) and *chaulmoogryl chaulmoograte*, $C_{17}H_{31}\cdot CO_2\cdot C_{18}H_{33}$ (m. p. 42°), together with unchanged chaulmoogric acid.

The saturated acid, *dihydrochaulmoogric acid*, $C_{17}H_{33}\cdot CO_2H$ (m. p. 71—72°, b. p. 248°/20 mm.; optically inactive), is formed, however, on reducing bromodihydrochaulmoogric acid with zinc dust and alcohol, or chaulmoogric acid with hydriodic acid and phosphorus. By the latter process, a hydrocarbon, *chaulmoogrene*, $C_{18}H_{34}$ (b. p. 193—194°/20 mm). is also formed. *Methyl dihydrochaulmoograte*, $C_{17}H_{33}\cdot CO_2Me$ (m. p. 26—27°, b. p. 222—223°/20 mm.), was prepared from the corresponding acid.

Chaulmoogric acid is not attacked by fused caustic alkalis even at 300°.

When chaulmoogric acid was oxidised with cold permanganate (1 atom oxygen), *dihydroxydihydrochaulmoogric acid*, $C_{17}H_{31}(OH)_2\cdot CO_2H$ (m. p. 102°), was produced, but when the amount of permanganate was equivalent to 4—5 atomic proportions of oxygen, formic acid and *two dibasic acids* were obtained, the latter having the formulæ $C_{15}H_{28}(CO_2H)_2$ and $C_{15}H_{28}O(CO_2H)_2$ (m. p. 128°). The *ethyl esters* of these acids were described.

The molecular magnetic rotation of ethyl chaulmoograte very closely approximates to the calculated value for an unsaturated ester of the formula $C_{20}H_{36}O_2$, having a closed ring and one ethylenic linking, the latter being contained in an allyl group. This conclusion, based on the magnetic rotation, is in harmony with the results obtained by the oxidation of the acid.

The further investigation of chaulmoogric acid is proceeding.

***102. "Gynocardin, a new cyanogenetic glucoside. Preliminary note." By Frederick Belding Power and Frank Howorth Gornall.**

In the course of an examination of the seeds of *Gynocardia odorata* (R.Br.), it was observed that when these were bruised and brought into water a strong odour of hydrogen cyanide is developed. This is due to the presence of a cyanogenetic glucoside, which the authors have isolated in a crystalline state, and designate *gynocardin*. It is very soluble in water, less freely in alcohol, and crystallises from these solvents in colourless needles which melt at 161—162° with slight decomposition, and have $[\alpha]_D^{19°}$ +37·1°; it gave on analysis the following percentages: C = 48·0; H = 5·8; N = 4·3. Its constitution is being determined.

103. "*iso*Nitrosocamphor." By Martin Onslow Forster.

An unstable *iso*nitrosocamphor (m. p. 114°), produced by the action of sodium and amyl nitrite on camphor, is converted into the yellow benzoyl derivative (m. p. 105—106°) on treatment with benzoyl chloride in pyridine, whilst the colourless benzoyl derivative (m. p. 136°) is produced in a similar manner from the stable *iso*nitrosocamphor (m. p. 152°).

Potassium ferricyanide oxidises both forms to an unstable *peroxide*, $C_{20}H_{28}O_4N_2$, which is insoluble in alkalis, and, the more fusible *iso*nitrosocamphor being attacked first, the isomeride can be freed from it by using insufficient oxidising agent.

The *O-methyl ether* of *iso*nitrosocamphor, $C_{11}H_{17}O_2N$, obtained by the action of methyl iodide in presence of silver oxide, crystallises in rectangular plates, melts at 107°, and has $[\alpha]_D$ +197·7°. Reduction converts it into aminocamphor, hydrolysis resolves it into α-camphornitrilic acid, and hydroxylamine gives rise to the *oxime*, $C_{11}H_{18}O_2N_2$, which melts at 188° and has $[\alpha]_D$ −95·3°.

The *N-methyl ether* of *iso*nitrosocamphor, $C_{11}H_{17}O_2N$, produced in association with the isomeride when methyl iodide acts on *iso*nitrosocamphor dissolved in alcoholic potash, is a pale yellow oil which decomposes on distillation and has $[\alpha]_D$ +279·8°. Dilute acids and alkalis hydrolyse the substance to camphorquinone and β-methylhydroxylamine, reduction with zinc dust and acetic acid converting it into methylaminocamphor; hydroxylamine gives rise to *iso*nitrosocamphor and the β-dioxime of camphorquinone, whilst phenylhydrazine transforms it into camphorquinonephenylhydrazone.

The decomposition of the colourless benzoyl derivative of *iso*nitrosocamphor on exposure to light yields the anhydrides of benzoic and α-camphornitrilic acids, the yellow isomeride giving rise to the same products. Determinations of molecular weight reveal no difference between the isomeric benzoyl derivatives.

The following derivatives of the camphorquinone dioximes have been examined. The *acetyl* α-dioxime (m. p. 148—149°), the *dibenzoyl* α-dioxime (m. p. 153°), the *diacetyl* β-dioxime (m. p. 119°), the *dibenzoyl* β-dioxime (m. p. 189°), the *benzoyl* γ-dioxime (m. p. 172°), and the *dibenzoyl* γ-dioxime (m. p. 159°).

104. **"The basic properties of oxygen. Additive compounds of the halogen hydrides and organic compounds, and the higher valencies of oxygen. Asymmetric oxygen." By Ebenezer Henry Archibald and Douglas McIntosh.**

An account was given of the preparation and properties of a number of compounds in which oxygen assumes a valency higher than two.

The following compounds have been prepared and analysed:

Acetone yields the hydriodide, $(CH_3)_2CO,HI$, the hydrobromide, $(CH_3)_2CO,HBr$, and the hydrochloride, $[(CH_3)_2{\cdot}CO]_2,5HCl$.

Ether gives rise to the compounds $(C_2H_5)_2O,HI$, $(C_2H_5)_2O,HBr$, and $(C_2H_5)_2O,5HCl$.

Ethyl alcohol furnishes the following series:

$C_2H_5{\cdot}OH,2HI$, $C_2H_5{\cdot}OH,2HBr$, and $C_2H_5{\cdot}OH,5HCl$.

These products are white compounds, crystallising readily from their solutions in the liquefied halogen hydrides and melting at temperatures varying between $-120°$ and $-9°$; they are prepared by mixing together the organic compound previously cooled to $-80°$ with the appropriate halogen hydride in the liquid state, considerable quantities of heat being generated by the reaction.

A compound of anisole and hydrogen bromide has been prepared, which is probably phenylmethyloxonium bromide having the constitution $\begin{matrix}CH_3\\C_6H_5\end{matrix}\!\!>\!O\!<\!\!\begin{matrix}H\\Br\end{matrix}$, and therefore containing an asymmetric oxygen atom. This and similar compounds are at present under investigation.

105. **"The fermentation of the indigo-plant." By Cyril Bergtheil.**

The fermentation of the indigo-plant has been ascribed to a bacterium and also to enzymes, but has hitherto never been satisfactorily investigated. The author shows that, although there are many bacteria capable of producing the fermentation, it is in the main due to a specific enzyme occurring in the plant cells. A very active solution of this enzyme has been obtained, and the course of the fermentation produced by adding this to an extract of the indigo plant made in boiling water has been studied. It is found that the fermentation proceeds in a similar manner to that observed by Adrian Brown for invertase (*Trans.*, 1902, **81**, 273) and by Horace Brown and Glendinning for diastase (*Trans.*, 1902, **81**, 388), namely, that equal quantities of substance are transformed in equal intervals of time in the early stages, but not in the later ones. The point at which the course of the change can no longer be represented by a

straight line is when 17 to 20 per cent. of the total action has taken place. The curve representing the reaction ceases to be linear at about the same point when the time factor is kept constant, but the quantity of acting enzyme varied.

The optimum temperature for the action is almost exactly 50°, and the temperature at which the enzyme is destroyed is 71°. The rate of action is decreased by the presence of both acids and alkalis. Sodium acetate up to 1 per cent. does not affect the rate of action. Various antiseptics all produced inhibition, formalin to the greatest, and boracic acid to the least extent. Emulsin can produce the indigo fermentation, but has a very weak action. It is doubtful whether the indigo enzyme can decompose amygdalin. Myrosin cannot ferment an extract of the indigo plant, and the indigo enzyme cannot ferment sinigrin. No evidence of the existence of an oxidase in the indigo plant was obtained.

106. "The union of hydrogen and chlorine. Action of the silent discharge on chlorine." By Joseph William Mellor.

By means of a special apparatus, chlorine can be subjected to any desired treatment before admixture with hydrogen without disturbing the equality of the proportions of hydrogen and chlorine in Bunsen and Roscoe's actinometer. The electrolytic gases are first sent through the liquid in the insolation vessel until a state of equilibrium is attained; the gases are then led into the insolation vessel without bubbling through this liquid at all.

If the chlorine gas is led through a glass "ozone-apparatus" before admixture with hydrogen, the period of induction is curtailed, as indicated in the third column of the following table. The numbers in the fourth column were obtained by the same apparatus, but the chlorine was exposed to the light of an acetylene flame before admixture with hydrogen. The numbers in the second column were obtained with chlorine not subjected to any previous treatment.

Time in minutes.	Ordinary chlorine.	Movement of index with (1) chlorine and silent discharge.	Movement of index with (2) chlorine and acetylene light.
1	0·1 cm.	1·8 cm.	2·5 cm.
2	0·1 „	4·4* „	4·2* „
3	0·4 „		
4	1·5 „		
5	3·0 „		
6	4·0* „		

The asterisk denotes that the gases afterwards united at a constant rate.

Moist chlorine is more chemically active towards hydrogen when subjected to (i) a preliminary exposure to light; or to (ii) a silent discharge of electricity.

Attempts are being made to isolate the active component.

107. "Studies on ethyl carboxyglutarate. Part II. Action of ethyl bromocarboxyglutarate on ethyl sodiocarboxyglutarate. Formation of ethyl carboxyglutaconate." By Oswald Silberrad and Thomas Hill Easterfield.

It was shown by the authors in the former part of the present work (this vol., 114) that ethyl sodiocarboxyglutarate is converted into haloid derivatives of ethyl carboxyglutarate by the action of halogens, no ethyl carboxydiglutarate being formed. For this reason, the reaction between ethyl bromocarboxyglutarate and ethyl sodiocarboxyglutarate has been examined.

On bringing together the haloid and sodium derivatives of ethyl carboxyglutarate, they react and give rise to a mixture of the original ethyl carboxyglutarate and a new unsaturated ester, $C_{12}H_{18}O_6$. The reaction, which appears to be unlike anything hitherto observed, may be represented as follows:

$$C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CNa(CO_2\cdot C_2H_5)_2 + C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CBr(CO_2\cdot C_2H_5)_2 = C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CH(CO_2\cdot C_2H_5)_2 + NaBr + C_2H_5\cdot CO_2\cdot CH_2\cdot CH{:}C(CO_2\cdot C_2H_5)_2.$$

This unsaturated ester is thus to be regarded as ethyl α-carboxy-$\Delta^{\alpha\beta}$-glutaconate. On saponification, it yields a new carboxyglutaconic acid, which readily breaks up into glutaconic acid and carbon dioxide:

$$C_3H_5(CO_2\cdot C_2H_5)_3 + 3H_2O = CO_2H\cdot CH_2\cdot CH{:}CH\cdot CO_2H + 3C_2H_5\cdot OH + CO_2,$$

from which it will be seen that its constitution must be represented by one of the following formulæ:

I. $C_2H_5\cdot CO_2\cdot CH{:}CH\cdot CH(CO_2\cdot C_2H_5)_2$ or

II. $C_2H_5\cdot CO_2\cdot CH_2\cdot CH{:}C(CO_2\cdot C_2H_5)_2$.

The latter of these formulæ must be the correct one, since the former represents ethyl *iso*aconitate, from which the new isomeride differs in containing no active hydrogen and hence forming no sodium derivative.

108. "The vapour pressures of liquid mixtures of restricted mutual solubility. Preliminary notice." By Arthur Marshall.

Although this subject has been somewhat fully treated from the theoretical side by Margules, Ostwald, Duhem, and others, yet with the exception of some somewhat rough measurements published by Konowaloff in 1881 and by Schreinemakers in 1900, no actual experiments have been made to test their conclusions. Experiments on mixtures of water with ether, methyl acetate, and more especially ethyl methyl ketone, have shown that in each case the curve for the total vapour pressure has much the same shape, but that this form is slightly different to those predicted by the foregoing authors.

When one of these comparatively volatile organic liquids is added gradually to water, the vapour pressure rises rapidly until the water becomes saturated. A second liquid phase then ensues and the curve becomes a horizontal straight line in accordance with the phase rule. When sufficient of the liquid has been added to dissolve the water completely, the curve again rises until it reaches a maximum, after which it falls again, until at 100 per cent. it coincides with the vapour pressure of the pure substance. It is in this portion of the experimental curve that the variation from the predicted forms is noticeable.

In consequence of this peculiarity, the liquid mixture, unless containing a very large proportion of one or other of its constituents, will yield a distillate having a composition approximating closely to that which gives the maximum point. For example, with mixtures of methyl ethyl ketone and water, if the original liquid contains between 10 and 90 per cent. of the ketone, the distillate will contain about 88·6 per cent. of this compound.

109. "The influence of solvents on the rotation of optically active compounds. Part V. The optical activity of certain tartrates in aqueous solution." By Thomas Stewart Patterson.

The rotations of sodium tartrate, potassium tartrate, potassium methyl tartrate, potassium ethyl tartrate, potassium *n*-propyl tartrate, methyl tartrate, ethyl tartrate, and *n*-propyl tartrate have been examined in aqueous solution at several concentrations and at temperatures between 10° and 100°.

In very dilute solution, sodium and potassium tartrates behave alike both as regards rotation value and influence of temperature-change, the rotation increasing as the temperature is raised.

It was shown that the rotations of the homogeneous compounds, could they exist in a superfused condition, would diminish on heating from 0° to 100°.

Of the three potassium alkyl tartrates, the *n*-propyl ester had the highest, and the methyl ester, the least rotation, both in dilute solution and in the homogeneous state. Dilute solutions of these compounds all showed distinct temperatures of maximum rotation.

The rotations of the three alkyl tartrates were all raised by solution in water, and in dilute solution the rotations diminished rapidly on heating, this behaviour being just the opposite of that shown by the homogeneous esters.

The rotations in very dilute solution of the compounds examined were compared with each other and with that of the tartaryl ion.

The relationships existing among the experimental data were discussed with reference to the variations produced by solution and by change of temperature, and some suggestions, based on these observations, were advanced with respect to the temperatures at which the comparisons of rotation values may legitimately be instituted.

110. "The nitration products of the isomeric dichlorobenzenes." By Percival Hartley and Julius Berend Cohen.

The progressive nitration of the dichlorotoluenes has been investigated by Cohen and Dakin (*Trans.*, 1902, 81, 1344), and the results show that the two nitro-groups in the dinitro-derivatives of the six dichlorotoluenes follow strictly the meta-law of substitution.

Since the publication of the above, three papers describing the nitration products of *o*-, *m*-, and *p*-dichlorobenzenes have appeared (Morgan, *Trans.*, 1902, 81, 1378; Blanksma and Terwogt, *Rec. trav. chim.*, 1902, 21, 286; and Blanksma, *ibid.*, 419).

From these it would appear that the principal products of nitration are an ortho-dinitro-compound in the case of *o*-dichlorobenzene, a meta-dinitro-compound in the case of *m*-dichlorobenzene, and a para-dinitro-compound in the case of *p*-dichlorobenzene. The authors have repeated the work in order to ascertain quantitatively how far the divergence from the meta-law holds good.

They have been able to confirm the results of nitration of the *o*- and *m*-dichlorobenzenes, but not of the para-compound. The first gives with great difficulty an ortho-dinitro-compound, the second much more easily a meta-dinitro-compound, but *p*-dichlorobenzene gives about six times as much of the meta-dinitro-compound as of its para-isomeride. The only important exception to the meta-law is therefore afforded by *o*-dichlorobenzene.

At the next meeting on Wednesday, June 15th, at 5.30 p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:—

"The mechanical analysis of soils and the composition of the fractions resulting therefrom." By A. D. Hall.

"The effect of the long-continued use of sodium nitrate on the constitution of the soil." By A. D. Hall.

"The decomposition of oxalates by heat." By A. Scott.

"Some alkyl derivatives of sulphur, selenium, and tellurium." By A. Scott.

"The ultra-violet absorption spectra of certain enol-keto-tautomerides. Part I. Acetylacetone and ethyl acetoacetate." By E. C. C. Baly and C. H. Desch.

"The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds." By J. N. Collie.

"Our present knowledge of the chemistry of indigo." By W. P. Bloxam.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, June 15th, 1904.

Bellars, Albert Ernest,
Magdalene College, Cambridge.

B.A. Demonstrator of Chemistry, Caius College. Part-author, Ethyl benzylideneanilineacetoacetate (*Trans.*, 1903, vol. 83).

M. M. Pattison Muir. S. Ruhemann.
R. S. Morrell. C. T. Heycock.
E. K. Hanson.

Brand, Herbert Frank, M.A.,
13, Clifton Road, Brockley, S.E.

Chief science master, "Westminster City" School. Master of Arts (London). Inter. Science (London), First Class (Chemistry and Physics). Passed B.Sc. (London), 1903, in Chemistry and Physics. Preparing B.Sc. (Honours) in Chemistry.

H. Wilson Hake. *Ernest J. Parry.*
J. C. Crocker. *D. B. Butler.*
J. B. Coleman. *Edward Bevan.*
C. T. Bennett. *C. F. Cross.*

Field, W. Eddington, F.I.A. A & M., Vic.,
65, Sutherland Road, Armadale, Melbourne, Victoria, Australia.

Analyst. I was principal Assistant for six years to the late William Johnson, Analyst to the Government of Victoria, and this last 19 years

I have been in practice in Melbourne as an Analytical and Technical Chemist. Reason for joining the Chemical Society—to try and keep in touch with Chemical Science through the Journal of the Society.

A. H. Jackson. Frederic Dunn.
Henry W. Levy. *D. Avery.*
A. W. Craig.

Gerard, Thomas Alfred,
122, Foxhall Road, Nottingham.

Soap Manufacturer. Studied Chemistry under Dr. Clowes, University College, Nottm., during 7 sessions. Managing director and chemist to Gerard Bros., Ltd., The Soap Wks., Nottm.

Frank Clowes. R. M. Caven.
E. T. Shelbourn. *G. D. Lander.*
F. J. R. Carulla.

Gilchrist, James Gray,
48, Ovington Street, Chelsea, S.W.

Science Teacher (Chemistry). Science Student; educated at Aberdeen University and Glasgow Technical College; M.A. of Aberdeen University; Student London Univ.

J. W. Shepherd. Hugh Manners.
G. G. Henderson. *William Briggs.*
Stuart Blofeld.

Hulme, John,
3, Albert Terrace, Stockport.

Journalist. Full course in General Chemistry in the School of Technology, M/c. Special courses in Gas Analysis, Water and Sewage Analysis, Oils and Fats, Chemistry of Essential Oils and Perfumes, and 3 years' extra course in Metallurgy. 1st class success in Cotton Dyeing, Calico and Linen Bleaching, and Calico Printing. Hons. Metallurgy. Desirous of obtaining the full literature published by the Society.

W. J. Pope. J. Allan.
Jas. Grant. F. S. Sinnatt.
S. J. Peachey.

Jenkins, Herbert,
52, Criffel Avenue, Streatham Hill, S.W.

Analytical Chemist. Member of the Chemical, Metallurgical, and Mining Society of South Africa. Desirous of joining the Chemical Society in order to keep pace with the general advancement of Chemical Science. For many years a student of the Birkbeck Institution and The City and Guilds Technical College, Leonard Street, Finsbury, E.C.

R. Meldola. Henry C. Jenkins.
John Castell-Evans. Bennett H. Brough.
F. Southerden. *W. Gowland.*

Johnston, John Haslam,

Public Offices, Hampton, Middlesex.

Chemist and Bacteriologist to the Hampton District Council. M.Sc., University of Manchester. F.I.C.; 3 years in the Chem. Laboratories of Owens College; 2 years in the Public Health and Pharmaceutical Laboratories of Owens College. Joint author with Prof. Delepine "On the effect of sedimentation on running water," *J. State Medicine.*

Harold B. Dixon. — D. L. Chapman.
William A. Bone. — R. S. Hutton.
G. H. Bailey.

Lessing, Rudolf,

31, Brunswick Square, W.C.

Chemist to the Gas Light and Coke Co., Lim., Tar and Liquor Works, Beckton, E. Studied at Munich, Geneva, Berlin. Ph.D., Munich. Worked 5 years under Adolph von Baeyer, and was private assistant to Professor Richard Willstaetter in researches on Diamidoacetic acid and on Quinonediimide. Papers: Ueber Benzolsulfamide (*Ber.*, 33, 557); Phenyl*cyclo*hexan aus Elsinit (*Ber.*, 34, 506); Ueber Methylpyrrolidindicarbonsäure (*Ber.*, 35, 2065). During Summer, 1903, Research Student at Owens College with Professor W. H. Perkin, jun.

H. B. Dixon. — Francis V. Darbishire.
W. H. Perkin, jun. — Norman Smith.
William A. Bone. — Thos. Wilton.
J. F. Thorpe. — Raphael Meldola.

Lowe, Frank Harold,

59A, Fulham Park Gardens.

Lecturer and Demonstrator in Chemical Department, South-Western Polytechnic. Held scholarship and studied 5 years at the Owens College (1892—1897). Graduated B.Sc., Victoria University, with 1st Class Honours in Chemistry, 1896. Late research student at Owens College. One year Demonstrator at the Royal Technical Institute, Salford (1898—1899). Four years Lecturer and Demonstrator at the S. W. Polytechnic (since 1899). Published a paper on "Picryl derivatives of urethane and thiourethane" (*Proc.*, April, 1904) in conjunction with Mr. J. C. Crocker.

J. B. Coleman. — J. Wilson.
J. C. Crocker. — Gerald T. Moody.
A. Harden. — *J. Hart-Smith.*

Oakden, William Edward,

2, Gledhow Terrace, South Kensington, S.W.

Lecturer in Chemistry and Metallurgy at the South-West London Polytechnic (about 6 years). Formerly (about 10 years) Technical Works Manager at Messrs. John Hutchinson and Co.'s Alkali Works, Widnes, and at Messrs. Gaskell, Deacon and Co.'s Works, Widnes, under the United Alkali Company, Ltd. Carried out original investigations and effected considerable improvements and economies in connection with Sulphuric Acid Manufacture and Recovery of Sulphur from Alkali Waste.

J. Bernard Coleman. G. W. F. Holroyd.
J. C. Crocker. William A. Davis.
Gerald T. Moody. *Frank Clowes.*

R. Grimwood.

Pell, Alfred,

44, Cumballa Hill, Bombay.

General Manager, Kemp and Co., Ltd., Manufacturing Chemists, Bombay, India. General Manager and Head Chemist for the last five years to Messrs. Kemp and Co., Ltd., the largest Manufacturing Chemists in India. Had charge of the Analytical Department for some time. Member of the Pharmaceutical Society. Editor and Compiler of "The Prescriber's Pharmacopœia" for the last four editions (a synopsis of recent remedies, specially written for India, 380 pages). I wish to keep in closer touch with present chemical progress.

John J. Pilley. David Hooper.
D. S. Kemp. Gerald Martin.

A. Milne.

Pinkerton, David John,

17, Orbiston Street, Motherwell.

Analytical Chemist. Three years a Student and one year Private Assistant with (the late firm of) Messrs. Wallace, Tatlock, and Clark, City Analysts, Glasgow; four years Chemist and Assistant Manager Paisley Corporation Gas Works; two years Chemist Glasgow Corporation Gas Works; at present Chief Chemist at Dalzell Steel and Iron Works (Messrs. D. Colville and Sons, Ltd.), Motherwell.

John Clark. R. T. Thomson.
R. R. Tatlock. A. Humboldt Sexton.

G. G. Henderson.

Rodger, Robert,

54, Rostrevor Road, S.W.

Analytical Chemist. Student, Royal College of Science, 1896–98. Since then Analyst in the Government Laboratory.

T. E. Thorpe. G. T. Morgan.
William A. Tilden. M. O. Forster.
C. Proctor.

Sanders, Percy Richard,

West Cliffe, Seaford, Sussex.

Chemical Officer under Inland Revenue Department. Student at Royal College of Science, London, 1896–7, 1897–8. Assistant Analyst at Government Laboratory, 1898—1900. Chemical Officer under Inland Revenue Department, 1900 to date.

T. E. Thorpe. H. W. Davis.
Geo. Stubbs. J. Holmes.
G. E. Tomlins.

Sawer, Charles John,

6, Cleveland Road, Brighton.

Student. Investigator of aromatic products. F.L.S. (elected 1881). Author of "Odorographia," 1892–94; "Rhodologia." Contributor to various technical publications and journals; such as the *Encyclopædia Britannica, Le Moniteur Scientifique, Descriptive Catalogues of Museums, The Pharmaceutical Journal, Chemist and Druggist, British and Colonial Druggist, Journal of the Imperial Institute, Knowledge, Journal of Applied Science, The Produce World, Bulletin of the Department of Agriculture, Jamaica, The West Indian Bulletin, Barbados.*

Peter MacEwan. W. H. Gibson.
Ernest J. Parry. *Benj. H. Paul.*
Herbert E. Burgess. *M. C. Clutterbuck.*
William Jago.

Shelton, Henry Stanley,

4, Larden Road, Acton Vale, W.

Teacher of Chemistry. Assistant in the Chemical Department, Northern Polytechnic Institute. Previously Science Master at the Grammar School, Thame, Oxford, and the Grammar School, Southwell, Notts. For 2 years (1901—1903) Ordinary and Research Student at University College, London.

William Ramsay. W. H. Mills.
F. G. Donnan. Samuel Smiles.
Morris W. Travers. Alex. W. Bain.

Weinberg, John,

Rosa United Provinces, India.

Chemist to Rosa Sugar Works and Distillery. Formerly Chemical Assistant: Experimental Station for Sugar Cane, Pasoeroean. Assistant: Station for Cane diseases, Probolinggo. Head Chemist: Pakkie's Sugar Mills. Published: Java Sugar *Archief*; Determination of Quotient of Purity of Cane juices; Sample taking of Sugar. And Agricultural Ledger, India; Deterioration of Cut Sugar Cane; Secondary constituents of Indian Country Spirits.

William Tate. W. T. Grice.
David Hooper. Paul Brühl.

P. C. Rdy.

Wilkinson, James Alfred,

Johannesburg.

Late Senior Science Master, Johannesburg College, Barnato Park, Johannesburg. Now Assistant Professor of Chemistry, Transvaal Technical Institute. First Class Natural Sciences Tripos, late Langworthy, Shakspere, and Seaton Scholar, Manchester Grammar School; Scholar of Gonville and Caius College, Cambridge. B.A., 1896, M.A., 1899. Seven years' experience in Science Lecturing and Teaching in Cambridge and Johannesburg.

M. M. Pattison Muir. R. S. Morrell.
S. Ruhemann. T. B. Wood.

J. Murray Crofts.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY SUFFOLK.

Issued 30/6/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 283.

Wednesday, June 15th, 1904. Prof. W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. G. Dean, C. D. McCourt, J. C. Smith, R. de J. Fleming-Struthers, and C. H. Thompson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William H. R. Allen, c/o Straits Trading Co., Butterworth, Penang, S.S.
Jabez Horace Cooper, 13, Victoria Terrace, Exeter.
George Frederick Phillips, B.Sc., Colworth Road, Leytonstone.
Edwin Roy Watson, B.A., B.Sc., 1, Fair Street, Cambridge.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Albert Ernest Bellars, B.A.
Herbert Frank Brand, M.A.
W. Eddington Field.
Thomas Alfred Gerard.
James Gray Gilchrist, M.A.
John Hulme.
Herbert Jenkins.
John Haslam Johnston, M.Sc.
Rudolf Lessing, Ph.D.
Frank Harold Lowe, B.Sc.
William Edward Oakden.
Alfred Pell.
David John Pinkerton.
Robert Rodger.
Percy Richard Sanders.
Charles John Sawer.
Henry Stanley Shelton.
John Weinberg.
James Alfred Wilkinson, M.A.

The PRESIDENT stated that six of the seven Past Presidents to whom the Society desired to do special honour at the Banquet held in 1898 having passed away, the Council felt that there should be no further delay in the publication of a memorial notice of the life and work of each. Arrangements had accordingly been made for the preparation of such notices, which, it was hoped, would be incorporated in the volume of Transactions for the present year. The list includes the name of Frankland, concerning whom a Memorial Lecture had been delivered by Professor Armstrong at a special meeting of the Society in October 1901. Repeated application for the manuscript having been unsuccessful, and nearly five years having elapsed since the death of Sir Edward Frankland, the Council were arranging for the preparation of an independent obituary notice.

The PRESIDENT further stated, for the information of the Society, that arrangements had been completed for the publication annually of Reports on the Progress of Chemistry under the several heads employed in the Journal for the classification of the Abstracts, with addition of a new section on "Radio-activity." It was expected that these reports, collected into an extra number of the Journal, would be ready for issue to the Fellows early in the spring of each year.

The attention of the Fellows was also requested to the notice inside the cover of the Journal relating to the International Tables of Atomic Weights, which are now printed on cards to be obtained from the Society's Agents, Messrs. Gurney and Jackson.

Of the following papers, those marked * were read:

***111. "The mechanical analysis of soils and the composition of the fractions resulting therefrom." By Alfred Daniel Hall.**

The object of the investigation was to ascertain the effect of introducing into the mechanical analysis of soils a preliminary treatment of the soil in dilute acid followed by ammonia as first suggested by Schlœsing. For the separation into fractions, the beaker method of sedimentation as worked out by Osborne was adopted, the soil being divided into two fractions by sieves and five by sedimentation from water. Eighteen soils of known history were selected from the Rothamsted experimental plots, to give comparisons of the same soil in an unmanured condition and when rich in humus through the accumulation of organic matter.

The proportions in which the groups of particles of given sizes occur in a soil are presumably constant for the particular type of soil;

the actual state of aggregation of the particles at any given time or place determines what may be termed the texture of the soil and depends on a number of temporary factors, such as the cultivation to which the soil has been subjected, the amount of humus present, the use of lime or of saline manures, &c. It is held that no method of mechanical analysis can measure the existing texture of the soil, although that texture does ultimately depend on the size of the particles composing the soil. If, however, the method of mechanical analysis can be made to show the ultimate physical constitution of the soil, a measure is obtained of the capacity of the soil to acquire a known texture under given methods of cultivation.

On comparing the results obtained by sedimenting the Rothamsted soils with and without the preliminary treatment in dilute acid, it is found that the raw soil rarely yielded as much of the finest or "klay" fraction as did the same soil after washing with acid, and that the difference was greatest when pastures and other soils rich in humus were examined, but practically disappeared with soils which had been deprived of their humus and deflocculated by long treatment with saline manures. As no valid reasons exist for supposing that the acid treatment can break down large particles into smaller ones, it is concluded that in carrying out a mechanical analysis on the raw soil many aggregates of the finest particles are left unresolved, but fall apart when the humates, which act as a weak binding material, are removed by the treatment with dilute acid followed by ammonia. A further action of the acid treatment is to remove all traces of soluble salts, which would otherwise cause flocculation and interfere with the sedimentation. It is only when dealing with soils containing a fair amount of humus that there will be much difference between the results obtained by the two methods, but, inasmuch as only the acid treatment yields an exact sorting out of the ultimate inorganic particles of the soil, whereas working on the raw soil leaves some of the finest particles still unseparated, the general conclusion is reached that the acid treatment should be adopted in all cases.

With the Rothamsted soils, the method involving a preliminary treatment with acid shows the essential identity of soils from the same experimental field whatever the manuring has been, whereas the analyses made on the raw soil give very different results, depending on the treatment the various plots have received.

Determinations made of the alumina, silica, and ferric oxide in the various fractions separated by mechanical analysis show that although the proportion of alumina increases as the particles composing the fraction become smaller, these fractions do not possess any chemical individuality, but are determined by the size and not by the chemical composition of the particles.

***112. "The effect of the long-continued use of sodium nitrate on the constitution of the soil." By Alfred Daniel Hall.**

On reviewing the results of the mechanical analysis of Rothamsted soils, it was observed that those which had been manured with sodium nitrate every year gave abnormal results; a further series of fifteen soils was examined drawn from each of the Rothamsted fields where plots with and without sodium nitrate occurred. In general, the use of sodium nitrate has resulted in a lower proportion of "klay" being left in the surface soil. This result was most manifest in the mangel field, where cultivation is frequent, and was not apparent at all in the grass field, where the turf protects the soil from the washing action of the rain.

The removal of the finest particles from the surface soil is attributed to deflocculation induced by the use of sodium nitrate and followed by the washing of the finest particles into the subsoil. This hypothesis is confirmed by chemical analysis of the "klays" separated in the mechanical analysis, by mechanical analysis of some of the subsoils, which were found to be richer in fine particles beneath the soils receiving nitrate, and by the condition of the same soils in the field, which showed every evidence of deflocculation.

Discussion.

Dr. Voelcker said that although he could not go so far as Mr. Hall in his estimation of the value of mechanical as against chemical analysis of soil, he nevertheless recognised the importance of the former and the advance which had been made with regard to it. It seemed, however, remarkable in the first paper that such similarity of composition was shown in the different separations formed by washing the soils.

In regard to the second paper he could, from his own experiments on the Woburn soil—a light sandy one and very different to that at Rothamsted—quite bear out what had been noticed with respect to the action of sodium nitrate. On washing the former soil continuously with solutions of this salt, the finer portions of soil were carried down and the subsoil after a time became quite different in texture, forming a consolidated mass through which the water would not percolate. This was due, no doubt, as the author had indicated, to the carrying down of the finer particles. In this respect, great differences were noted between the action of sodium nitrate and that of the sulphate and other salts of ammonium.

Dr. E. J. Russell pointed out that what was really wanted was a

knowledge of the total surface of the soil particles to a depth of say six inches; mechanical analysis gave very useful results but was not entirely satisfactory. There are some fundamental objections to the method; small particles from near the bottom of the column of liquid are deposited along with the larger particles which take the same time to travel from the top, and the deposit is therefore a mixture. Moreover, a disc-shaped particle will tend to place itself broadside on and be deposited simultaneously with a spherical particle of about the same sectional area. Consequently, it cannot be assumed that the particles have even approximately the same surface, although under the microscope the sediment may appear to be fairly homogeneous.

Mr. F. J. Lloyd said that the study of the physical nature of the soil had been neglected in England, whereas the remarkable researches of Whitney in America had shown that valuable information could be derived from this investigation. He regretted that the author had stated that the physical study yielded more important results than the chemical examination, because in his opinion the nature of the soil could only be discovered by the investigation of both its physical and chemical properties.

Mr. T. S. Dymond pointed out that the method employed by the author involved the complete disintegration of the soil aggregates produced by years of cultivation. What information of value bearing on the proper treatment of cultivated land could be obtained if the previous history of the soil were obliterated previous to analysis? More practical knowledge could be gained by the rough examination of the soil of a field with a spade than by the old methods of mechanical analysis. Would not this be still more true of the method now proposed?

Dr. Luxmore said that as the aim of mechanical analysis was to determine the structure of the soil it was needful in the first place to know the total quantity of the finest materials, which sometimes formed a layer over the coarser particles. If in addition to this a method could be derived by which the state of tilth could also be determined this would be a further advantage. One great benefit of the preliminary treatment with acid lay in the saving of time which it involved in a long and tedious process. From his own observations on the soils of Dorset he knew that the dissolved material other than calcium carbonate was very small in amount.

Mr. Hall, in reply, said that he would not attempt to consider the question raised by Dr. Voelcker and Mr. Lloyd as to the value of the mechanical analysis of a soil; the method, however, aimed at gauging the behaviour of a soil towards water, and the size of crops even in this humid climate was determined more by the amount of water available than by the soil constituents usually regarded as plant food. He

agreed with Dr. Russell that the working surface of the soil particles was probably the factor of most importance, and one which could only be imperfectly deduced from the mechanical analysis. He did not, however, anticipate that it would be possible to estimate directly the behaviour of a soil in the field from any of the measurements they could obtain; the function of the mechanical analysis was rather to enable one to relegate a given soil to one or other of certain known types, the working qualities of which had been already ascertained by experience. This meant, then, the accumulation of the necessary data for a number of soils, and the first essential was to obtain a method which was so far accurate that it represented the permanent and not the accidental or temporary features of the soil.

***113. "The decomposition of oxalates by heat." By Alexander Scott.**

In spite of the simple formulæ given to the oxalates, their decomposition by heat is by no means as simple as usually stated. Ordinary precipitated calcium oxalate turns grey on ignition, and this change, which is due to the separation of small quantities of carbon, occurs even with the purest calcium oxalate. This salt gives very little carbon dioxide and carbon, but always a little of each, decomposing practically in accordance with the equation usually given, $CaC_2O_4 = CaCO_3 + CO$.

Sodium and barium oxalates decompose in accordance with the following equations:

$$7Na_2C_2O_4 = 7Na_2CO_3 + 3CO + 2CO_2 + 2C,$$
$$8BaC_2O_4 = 8BaCO_3 + 6CO + CO_2 + C.$$

Magnesium oxalate gives exactly equal volumes of carbon dioxide and monoxide and no carbon, $MgC_2O_4 = MgO + CO + CO_2$, but almost all the other oxalates tested gave notable quantities of carbon dioxide and carbon.

***114. "Some alkyl derivatives of sulphur, selenium, and tellurium." By Alexander Scott.**

When sulphur is heated at 180° with methyl iodide, 1 atom unites directly with 3 molecules of the iodide, forming the di-iodide of trimethyl-sulphine iodide, which is obtained as an almost black oil, but after this has been freed from excess of methyl iodide the solid, $S(CH_3)_3I,I_2$, may be obtained by dissolving the oil in ethyl acetate and precipitating by means of ether, when it separates in dark purple scales melting at 38°. Selenium behaves in an exactly similar way, the $Se(CH_3)_3I,I_2$ melting at 39°. To reduce these to trimethyl-sulphine and -selenetine

iodides, water is added to their solutions in ethyl acetate and hydrogen sulphide is passed in until the liquid is colourless.

As Demarçay has shown, the action of methyl iodide on tellurium at 80° gives rise to tellurium dimethyl di-iodide, $Te(CH_3)_2I_2$, but this is not decomposed by heating to 180°, nor does it give a compound corresponding with those obtained from sulphur and selenium. To obtain tellurium trimethyl iodide, the di-iodide is dissolved in methyl iodide and equivalent quantities of sodium sulphite and sodium carbonate are added. The reaction takes place thus:

$$Te(CH_3)_2I_2 + CH_3I + Na_2SO_3 + H_2O = Te(CH_3)_3I + Na_2SO_4 + 2HI,$$

the hydrogen iodide being then neutralised by the sodium carbonate. The tellurium trimethyl iodide is readily separated from the sodium salts by crystallisation.

The di-iodide of tellurium trimethyl iodide, produced by adding iodine to the iodide, is readily obtained in fine purple scales (m. p. 76·5°) by precipitation of its solution in ethyl acetate by means of ether.

Allyl iodide readily dissolves tellurium in the cold, giving an orange-coloured oil, from which the element is very readily obtained again. Ethyl iodide reacts in the same way as methyl iodide.

The author showed several reactions of tellurium dimethyl di-iodide and its derivatives.

***115. "The ultraviolet absorption spectra of certain enol-keto-tautomerides. Part I. Acetylacetone and ethyl aceto-acetate." By Edward Charles Cyril Baly and Cecil Henry Desch.**

An attempt was made to determine the constitution of the metallic derivatives of acetylacetone and ethyl acetoacetate by means of their ultraviolet absorption spectra. The absorption spectra of alcoholic solutions of the aluminium, beryllium, and thorium derivatives of acetylacetone and the aluminium compound of ethyl acetoacetate were photographed, as well as those of the parent substances. Hartley and Huntington's method of experiment was adopted, but a different method of drawing the curves of absorption was employed. From a consideration of the absorption curves of acetylacetone and its metallic derivatives, it is evident that the constitution of these substances is very similar, as they all show a strong absorption band, the limits of which are very much the same in every case.

Ethyl acetoacetate, on the other hand, shows no absorption band, whilst its aluminium derivative shows a strong band almost identical with those of the acetylacetone group.

These results appeared at first to indicate that acetylacetone and its

derivatives and the aluminium compound of ethyl acetoacetate had the enolic formula, and suggested the keto-formula for ethyl acetoacetate itself. This view was not upheld by the study of the spectra of ethyl ethylacetoacetate, and its isomeride, ethyl β-ethoxycrotonate; in both cases, only continuous absorption was obtained without any band at all. The band therefore cannot be characteristic of either the enolic or the keto-modification, but appears to be due entirely to the dynamic isomerism between the two forms. Experiments were made to test this by observing the action of sodium hydroxide or hydrochloric acid, which should materially alter either the size or the persistence of the absorption band; the former reagent should increase it, and the latter decrease it owing to their accelerating and retarding influence respectively on the dynamic isomerism. It was found that a very small amount ($\frac{1}{2}$ equivalent) of sodium hydroxide produced a band in the absorption spectrum of ethyl acetoacetate, this band being increased by the addition of more alkali until with excess it was larger and more persistent than that given by the aluminium derivative. Hydrochloric acid was found to have a marked action in decreasing the absorption of ethyl acetoacetate; its action was better observed in the case of ethyl β-aminocrotonate, when it was found that the absorption band was decreased more and more by repeated addition of small quantities of the acid.

The conclusion is therefore drawn that with acetylacetone, ethyl acetoacetate, and their metallic derivatives, a state of dynamic isomerism exists in the solution; that the presence of the band in their absorption spectra is due to this isomerism, and that its persistence is a measure of the number of molecules in the state of vibration. It would thus appear that the absorption band is a method of measuring the amount of reaction taking place between two isomeric substances which are in equilibrium.

***116. "The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds." By John Norman Collie.**

The action of acetyl chloride on the sodium salt of diacetylacetone was investigated with the object of determining whether the introduction of two acetyl groups into dimethylpyrone would destroy its property of forming salts with acids.

As a result of the action of acetyl chloride dissolved in chloroform on the sodium salt, a compound melting at 124° was obtained, which was undoubtedly diacetyldimethylpyrone (compare Thomas and Lefèvre, *Bull. Soc. chim.*, 1888, 50, 193—194). On repeating this operation, the chief substance produced melted at 954°, whilst in another experi-

ment, in which the substances were allowed to react at the temperature of a freezing mixture, a compound melting at 75° was obtained.

These three substances were isomeric, having the formula $C_{11}H_{12}O_4$, and were produced according to the equations:

$$C_7H_8O_2 + 2NaOH = C_7H_8O_3Na_2 + H_2O.$$
$$C_7H_8O_3Na_2 + 2C_2H_3OCl = C_7H_6O_2(C_2H_3O)_2 + 2NaCl + H_2O.$$

(1) Diacetyldimethylpyrone gave no coloration with ferric chloride, and could be sublimed; when boiled with barium hydroxide solution, a yellow barium salt was produced, which dissolved in dilute hydrochloric acid and gave a deep red coloration with ferric salts. Bromine was not decolorised by it. The original substance was totally devoid of any basic properties, and gave neither a hydrochloride nor a platinichloride.

(2) The compound melting at 95° gave a purple coloration with ferric chloride solution, and the orcinol reaction with chloroform and caustic soda. When heated with 80 per cent. sulphuric acid, acetic acid and orcinol were obtained; it gave, with bromine, a monobromo-derivative, ($C_{11}H_{11}O_4Br$) (m. p. 79°), and, with acetic anhydride, a monoacetyl derivative, $C_{11}H_{11}(C_2H_3O)O_4$ (m. p. 75°). It dissolves in aqueous soda with a yellow colour, and, after boiling, can be reprecipitated unchanged on the addition of an acid; it is, therefore, diacetylorcinol.

(3) The third substance (m. p. 75°) also gave a purple-red coloration with ferric chloride; it decolorised a solution of bromine in the cold, and, after heating for some time, gave the orcinol reaction with caustic soda and chloroform, but, on warming with this alkali, it also was transformed into the compound melting at 94°, whilst with hydrochloric acid it changed into diacetyldimethylpyrone (m. p. 124°). These curious transformations receive scanty explanation from the accepted molecular constitution of dimethylpyrone, and formulæ for pyrone and its derivatives were brought forward with the view of explaining the foregoing transformation.

***117. "Our present knowledge of the chemistry of indigo." By William Popplewell Bloxam.**

As the determination of the maximum amount of indigo obtainable at each successive stage of its preparation ("mahai") and of the quantity present in the leaf of the green plant depends on the purity of the indigotin employed as a standard, the author has estimated the percentage of nitrogen in the best specimens procurable, and has thus found that they contain only about 90 per cent. of indigotin.

Since the pure substances could not be prepared by the action of

solvents on cake indigo or the synthetical product, the crude indigo was sublimed under diminished pressure, and in this way a well crystallised product was readily obtained which gave the percentage of nitrogen required for indigotin.

This pure material when sulphonated and subjected to analysis by the permanganate method was found to give values ranging up to 300 per cent. of the weight of substance taken. As this method is used in ordinary technical analyses of indigo, this result explained the extraordinary variations observed in the published values given for cake indigo and the products obtained during the successive stages of the manufacture ("mahai").

It has also been found that the red substance occurring in the cake obtained from plant-indigo and known as "indirubin" or indigo-red, is not, as stated, a derivative of indigo, as it contains no nitrogen. This material, which may consist of a mixture of compounds, will be further investigated.

118. "$\Delta^{1:3}$-Dihydrobenzene." By Arthur William Crossley.

Dibromotetrahydrobenzene, prepared by Baeyer's method (*Annalen*, 1894, 278, 88), is a colourless, highly refractive liquid, boiling at 116—117°/29 mm. When treated with concentrated alcoholic potassium hydroxide, it yields a small quantity of $\Delta^{1:3}$-dihydrobenzene, but principally the *ethyl ether*, $C_6H_9{\cdot}O{\cdot}C_2H_5$, of *hydroxytetrahydrobenzene* as a colourless liquid boiling at 155°, and possessing a pungent odour of peppermint.

Quinoline removes two molecules of hydrogen bromide from dibromotetrahydrobenzene, giving $\Delta^{1:3}$-dihydrobenzene, which boils at 81·5—82°/767 mm., and, like the dihydrobenzene obtained from dihydroresorcin (Crossley and Haas, *Trans.*, 1903, 83, 494), is characterised by only adding on two atoms of bromine to form 1 : 4-dibromo-Δ^2-tetrahydrobenzene melting at 104·5°, and decomposing with evolution of hydrogen bromide at 170°. That this substance is in reality a dibromotetrahydrobenzene is proved by the fact that on treatment with quinoline it loses two molecules of hydrogen bromide with formation of benzene.

119. "The absorption spectrum of *p*-nitrosodimethylaniline." By Walter Noel Hartley.

It was pointed out that the usual formula assigned to benzoquinone is less consistent with its chemical properties as an oxidiser than the peroxide formula and that an unreduced benzene ring is in accord with

the optical properties of the substance, since its spectrum exhibits powerful absorption bands. The usual formula, on the other hand, contains the partially reduced carbon ring present in hydroaromatic substances, and the spectra of these are characterised by an absence of absorption bands. The absorption bands in the ultra-violet are always associated with the production of colours, even when the substance examined shows no visible colour, and such substances are in reality chromogens (*Trans.*, 1887, **51**, 154—202). Nitroso-compounds of the aromatic series have a powerful and extensive selective absorption in the ultra-violet, and it was thought possible to draw a distinction between these and the closely related oximes.

The following conclusions were deduced: 1. The absorption caused by *p*-nitrosodimethylaniline at the less refrangible end extends into the infra-red, and at the more refrangible far into the ultra-violet. The transmitted rays are thus restricted to a band of yellow and green light bordered on either side by a band of intense absorption.

2. There appears to be a decided difference in constitution as judged by their spectra between *p*-nitrosophenol or quinoneoxime and *p*-nitrosodimethylaniline which cannot be accounted for by a substitution of hydroxyl for the group $N(CH_3)_2$.

3. The alkyl substituted phenols and anilines absorb varying quantities of the ultra-violet, the absorption not extending into the visible spectrum, but the introduction of the NO, as distinguished from the NOH group, extends the absorption far into the coloured rays. This appears to be a characteristic effect of the nitrosyl group in conjunction with the benzene ring.

4. Although the absorption of rays in the blue and violet by *p*-nitrosodimethylaniline is strong, there is at a certain dilution a transmission of the greater part of the ultra-violet.

This explains the action of Wood's screen, which cuts off the visible rays while it transmits some of the ultra-violet. On testing the solutions of *p*-nitrosodimethylaniline, it was found that some red rays were still transmitted, but it is quite possible to adjust the thickness of the solutions so that with a quartz lens and electric light what appears to be perfect darkness causes the fluorescence of uranium nitrate and barium platinocyanide. The appearance of the crystals was brightest when some obscure or feeble blue rays were transmitted.

From a consideration of the facts referred to in connection with conclusion 3, and the previous observations on benzoquinone and its oxime, dioxime, chloroimide, and dichloroimide, it appears to be not improbable that a solution of *p*-nitrosophenol is a mixture of two tautomeric forms, the one a phenol and the other an oxime.

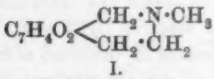
120. "The influence of solvents on the rotation of optically active compounds. Part VI. The relationship between solution-volume and rotation of the dialkyl and potassium alkyl tartrates in aqueous solution." By Thomas Stewart Patterson.

Values for the molecular solution-volumes of dimethyl-, diethyl-, di-*n*-propyl, potassium methyl-, potassium ethyl-, and potassium *n*-propyl-tartrates are given, and the changes of volume due to solution in water compared with the corresponding changes in rotation. It is shown that in both series a contraction of 1 c.c. per gram-molecule produces the greatest change of rotation in the methyl and the least change of rotation in the *n*-propyl ester, and that the perplexing rotation changes of these compounds, due to solution in water, can at least be brought into harmony when a causal connection between solution-volume and rotation is assumed.

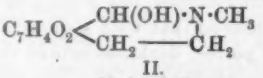
121. "The constitution of hydrastinine." James Johnston Dobbie and Charles Kenneth Tinkler.

The study of the absorption spectra of hydrastinine, $C_{11}H_{13}O_3N$, has yielded results precisely similar to those obtained with cotarnine (*Trans.*, 1903, **83**, 598).

Solutions of hydrastinine in ether or chloroform are, like the solid substance, colourless, and their absorption spectra are practically identical with the spectra of hydrohydrastinine, a compound which is generally considered to have the constitution represented by formula I. From this, it is argued that the carbinol formula II, which represents hydrastinine as differing from hydrohydrastinine only in the replacement of an atom of hydrogen by a hydroxyl group, should be preferred to the open-chain or aldehydic formula of Roser, which would leave the agreement between the absorption spectra of the two substances entirely unexplained.



I.
Hydrohydrastinine.



II.
Hydrastinine (carbinol form).

On the other hand, the aqueous or alcoholic solutions of hydrastinine, which are yellow and fluorescent, give spectra which agree with those of the hydrastinine salts. It would therefore appear that, under the influence of these solvents, hydrastinine changes from the carbinol to the ammonium base, the hydroxyl group shifting from the carbon atom to the nitrogen and forming the complex $>N(CH_3)\cdot OH$.

The spectra of the colourless solutions agree closely with those of the corresponding solutions of cotarnine. The spectra of the coloured solutions possess three absorption bands corresponding in position with two bands in the cotarnine spectra.

All the hydrastinine derivatives examined give spectra which are identical or nearly so with those of hydrohydrastinine or of the hydrastinine salts.

Alcohol imparts a yellow colour to an ethereal solution of hydrastinine, the depth of colour increasing as the proportion of alcohol to ether is increased. An examination of the spectra of such solutions shows that as alcohol is gradually added the carbinol form changes into the ammonium base form. The opposite change is brought about by the addition of alkalis to the yellow solution of hydrastinine compounds, the disappearance of the fluorescence marking the complete conversion of the ammonium base form into the carbinol form.

122. **"The influence of moist alcohol and ethyl chloride on the boiling point of chloroform." By John Wade and Horace Finnemore.**

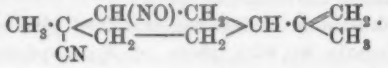
Chloroform, when made from alcohol, contains a small quantity of ethyl chloride, the absence of which from chloroform made from acetone detracts from its efficiency as an anæsthetic. The ethyl chloride depresses the boiling point of the chloroform; it was partially isolated by fractionation through a Young's evaporator column, and was identified by conversion into silver propionate.

Incidentally, the authors have isolated binary mixtures of chloroform and alcohol, and chloroform and water, and a ternary mixture of chloroform, alcohol, and water, all of minimum boiling point. The first binary mixture boils at 59·4°/760 mm., has a sp. gr. 1·4125 at 15°/15°, and contains 7 per cent. of alcohol. The second binary mixture boils at 56·1°/760 mm., and contains about 1 per cent. of water. The ternary mixture boils at 55·5°/760 mm., and contains 4 per cent. of alcohol and about 3·5 per cent. of water. The water in both these mixtures separates at once from the distillate.

123. **"Limonene nitrosocyanides." By William Augustus Tilden and Frederick Peacock Leach.**

The nitrosocyanide referred to (*Proc.*, 1902, 18, 163) by Tilden and Burrows as a liquid is found to be a crystalline, optically active solid, m. p. 90—91°, and $[\alpha]_D$ +165°; it yields a benzoyl derivative, which crystallises in shining plates melting at 107°. The nitrosocyanide has

a monomolecular structure, $C_{10}H_{16}NO\cdot CN$, and, the formula for limonene having been recently established by Perkin, the nitrosocyanide must be represented as follows:



This compound is obtained by digesting limonene β-nitrosochloride with potassium cyanide. It is also the chief product of the same treatment of the mixed α- and β-nitrosochlorides. It has not yet been obtained from pure α-nitrosochloride, which yields a viscid product, but from the latter a benzoyl compound is obtained, which is identical with the benzoyl derivative of the β-nitrosocyanide. The investigation will be continued.

124. "Photochemically active chlorine. II. A preliminary notice." By Charles Hutchins Burgess and David Leonard Chapman.

A considerable number of experiments have now been performed with the purpose of discovering the conditions under which the activity of chlorine gas or its solution is induced and destroyed (this vol., p. 52), the following being a brief summary of some of the results obtained:

(1) Active chlorine is formed by the action of light or heat on inactive chlorine. (2) Moist chlorine, when heated to the boiling point of water and then cooled to the ordinary temperature, is rendered almost as active as by the action of light. (3) By the passage of the electric discharge through inactive chlorine (compare J. W. Mellor, this vol., p. 140).

It has also been shown that freshly prepared electrolytic gas and chlorine are almost at their maximum activity, and in measuring the activity of either of these gases it is very necessary to make sure that the chlorine contained in the control actinometer is inactive.

It has now been observed that aqueous solutions of certain acids and salts are more effective in removing the activity than pure water.

An active solution of chlorine in water can be prepared either by leaving the liquid in contact with active chlorine or by heating aqueous solutions of chlorine.

Only a very small fraction of the activity is removed by pumping the chlorine out of an active solution under diminished pressure, and when an active solution is distilled in a vacuum both the distillate and the residual liquid are active. Aqueous solutions of chlorides through which ozone has been passed are more active than solutions of the same strength which have not been thus treated.

The residual liquid remaining after removing the chlorine under

diminished pressure, when treated successively with potassium iodide and $N/10$ thiosulphate, still retains a large proportion of its activity.

The condition of the moist chlorine having been found to be the cause of the induction period, experiments were made for the purpose of deciding whether this phenomenon is due to the formation of a compound of the type Cl_2,H_2O, which is subsequently destroyed by hydrogen with the formation of hydrochloric acid. Comparative measurements of the induction period and of the rate of formation of hydrochloric acid after the induction period were made, and on applying the law of mass action to the results it was seen that if the foregoing assumption is correct then at least one-half of the chlorine in the actinometer must have been converted into the compound Cl_2,H_2O before hydrochloric acid began to be formed in appreciable quantity, a result which is obviously absurd.

The conditions of formation of active chlorine precisely correspond with those which are known to be necessary for the substitution of hydrogen in the side chain of a benzene compound.

125. "Additive compounds of anhydrous magnesium bromide with organic oxygen and nitrogen compounds." By John Joseph Sudborough, Harold Hibbert, and Stanley H. Beard.

In attempting to prepare $\begin{matrix}CH_2\cdot C(OEt)(OMgBr)\cdot CH_2\\ |\\ CH_2\cdot C(OEt)(OMgBr)\cdot CH_2\end{matrix}$ by the action of a dry ethereal solution of ethylene dibromide on ethyl succinate in the presence of dry magnesium, an additive compound of magnesium bromide and ethyl succinate was obtained. This is an extremely hygroscopic, crystalline solid which may readily be prepared by the direct union of its components; it has the composition $(CH_2\cdot CO_2Et)_2,MgBr_2$.

Additive products of other organic oxygen compounds, such as ether, amyl ether, benzaldehyde, cinnamaldehyde, benzophenone, pyruvic acid, and ethyl benzoate, have been obtained. Amines and nitrites appear to be capable of forming similar additive compounds, whereas hydrocarbons are not.

The compounds are all extremely hygroscopic and difficult to obtain quite pure.

126. "Differentiation of primary, secondary, and tertiary amines. A preliminary note." By John Joseph Sudborough and Harold Hibbert.

L. Meunier (*Compt. rend.*, 1903, **136**, 758) has shown that primary and secondary amines react with magnesium methyl iodide in ethereal

solution according to the equations $RNH_2 + CH_3 \cdot MgI = RNH \cdot MgI + CH_4$ and $RR'NH + CH_3 \cdot MgI = RR'N \cdot MgI + CH_4$.

It is now shown that with primary amines and a solution of magnesium methyl iodide, in amyl ether the reaction proceeds quantitatively in the cold, as stated by Meunier, but that when the solution is heated a second molecule of methane is set free, presumably according to the equation $RNH \cdot MgI + CH_3 \cdot MgI = RN(MgI)_2 + CH_4$.

When a secondary amine is used, only one molecule of methane is evolved for each gram-molecule of the compound, even on heating.

Tertiary amines do not evolve any gas when mixed with Grignard's reagent.

The compounds examined so far have been *p*-toluidine, β-naphthylamine, diphenylamine, carbazole, and dimethylaniline. It is the intention of the authors to extend the work, and on these reactions to base methods for the characterisation of amino- and imino-groups and for the estimation of the amounts of primary, secondary, and tertiary amine in a mixture.

127. "Influence of radium radiations on labile stereoisomerides." By John Joseph Sudborough.

The relative effects of exposing labile stereoisomerides to sunlight and to radium radiations have been examined. The substances used were *allo*-cinnamic, α-bromo-*allo*-cinnamic, and β-bromo-*allo*-cinnamic acids.

It has been already shown (Trans., 1903, **83**, 685, 1166) that these acids are transformed to a large extent into the more stable isomerides by the action of light or heat.

Prolonged exposure in the dark to the rays from pure radium bromide (1 mg.) does not affect the melting points of the acids.

The three acids, melting respectively at 68°, 120—121°, and 159—160°, were exposed to the radiations during a period of four months: at the end of this time no change in appearance and practically no alteration in melting point could be detected; the melting points found were 68°, 118—121°, and 158—160°. Specimens of the same acids were exposed to sunlight on March 17th, and by April 7th the melting points were considerably affected. The *allo*-cinnamic acid then began to melt at 60°, the α-bromo-*allo*-acid at 100°, and the β-bromo-*allo*-acid at 145°. On June 13th, the *allo*-cinnamic acid began to melt at 60° and was nearly completely fused by 120°, although a small amount of solid still remained at 145°. The α-bromo-*allo*-acid began to melt at 90° and was completely fused at 105°; the β-*allo*-acid began to melt at 120° and was completely fused at 135°,

thus indicating that the three *allo*-acids are transformed into the stable isomerides more readily under the influence of light than by prolonged exposure to radium radiations.

128. "**Notes on analytical chemistry.**" By Gilbert Thomas Morgan.

I. *The Separation of Arsenic by Distillation in Hydrogen Chloride.*—A modification of Piloty and Stock's apparatus (*Ber.*, 1897, 30, 1649) was described in which the mixed sulphides of arsenic and antimony were distilled in a current of hydrogen chloride, so that the vapours did not come into contact with organic matter until after passing through a cooled aqueous solution of hydrogen sulphide.

In dealing with a mixture containing arsenic in the two states of oxidation, the distillation was first carried out in hydrogen chloride, when the arsenious sulphide precipitated in the receiver represented the tervalent arsenic. On repeating the distillation of the residual liquid in a current of hydrogen chloride mixed with hydrogen sulphide a second precipitation of arsenious sulphide was obtained, this being derived from the arsenic originally present in the quinquevalent condition.

II. *The Estimation of Carbon by Oxidation with Chromic Acid.*—Phosphoric acid was substituted for sulphuric or hydrochloric acid in the gravimetric estimation of carbon dioxide in native carbonates, and when these substances contained organic matter, chromic acid was subsequently added to the contents of the distilling flask and the operation repeated, the second increase in weight of the tared absorption tube being due to the oxidation of the organic carbon.

The mixture of chromic and phosphoric acids was also used in estimating the total carbon in cast iron and ferromanganese, the employment of a non-volatile acid instead of sulphuric acid obviating the risk of carrying over acid fumes into the weighed absorption tube.

129. "**Nitrogen chlorides containing two halogen atoms attached to the nitrogen.**" By Frederick Daniel Chattaway.

Very few substituted nitrogen chlorides containing two halogen atoms attached to a single nitrogen atom have been prepared, the best known being those derived from the primary alkylamines.

Stable, well-crystallised compounds having the general formula $RSO_2 \cdot NCl_2$ are yielded by all the sulphonamides, and a few have already been described by Kastle, Keiser, and Bradley (*Amer. Chem. J.*, 1896, 18, 491).

They are also easily prepared by dissolving the sulphonamides in a solution of bleaching powder and adding acetic acid, when they separate as crystalline solids.

The dichloroaminosulphonamides are not easily hydrolysed even by boiling with water; they dissolve in caustic alkalis, apparently yielding salts of the monochlorosulphonamides, which can be recrystallised from water. With hydrochloric acid, hydriodic acid, or alcohol, they react vigorously, the sulphonamides are regenerated, and chlorine, iodine, or ethyl hypochlorite is liberated. On heating rapidly, the dichlorosulphonamides decompose with slight explosion, whilst the tetrachlorodisulphonamides explode with great violence. This behaviour is noteworthy, as the latter compounds are the only substituted nitrogen chlorides yet prepared which detonate in a way resembling the explosion of nitrogen chloride itself.

These compounds, as well as the chlorosulphonalkylamides and the corresponding bromine derivatives, are being further studied, as they are very reactive and promise to be of considerable value in organic synthesis. Moreover, the dichlorosulphonamides are so easily prepared, crystallised, and analysed that they may prove of considerable use in the investigation of sulphonic acids.

The following compounds were described:

Benzenesulphondichloroamide, $C_6H_5\cdot SO_2\cdot NCl_2$, colourless plates, m. p. 76°; *p*-toluenesulphondichloroamide, $CH_3\cdot C_6H_4\cdot SO_2\cdot NCl_2$, long, four-sided prisms, m. p. 83° (Kastle, Keiser, and Bradley, *loc. cit.*); *o*-toluenesulphondichloroamide, $CH_3\cdot C_6H_4\cdot SO_2\cdot NCl_2$, colourless plates, m. p. 33°; *m*-nitrobenzenesulphondichlorodiamide, $NO_2\cdot C_6H_4\cdot SO_2\cdot NCl_2$, faintly yellow, six-sided plates, m. p. 121°; *o*-nitrotoluene-*p*-sulphondichloroamide, $CH_3\cdot C_6H_3(NO_2)\cdot SO_2\cdot NCl_2$ (1 : 2 : 4), pale yellow, four-sided prisms, m. p. 101°; benzene-*m*-disulphontetrachloroamide, $C_6H_4(SO_2\cdot NCl_2)_2$, colourless rhombs, m. p. 128°; naphthalene-1-sulphondichloroamide, $C_{10}H_7\cdot SO_2\cdot NCl_2$, pale yellow plates, m. p. 91°; naphthalene-2-sulphondichloroamide, colourless plates, m. p. 68°; naphthalene-2 : 7-disulphontetrachloroamide, $C_{10}H_6(SO_2\cdot NCl_2)_2$, clusters of colourless pyramids, m. p. 165°; anthraquinone-2-sulphondichloroamide, $C_{14}H_7O_2\cdot SO_2\cdot NCl_2$, yellow plates, m. p. 177°.

130. "Sulphonphenylchloroamides and sulphontolylchloroamides." By Frederick Daniel Chattaway.

In a paper on the action of sodium hypochlorite on the aromatic sulphonamides, Raper, Thomson, and Cohen (*Trans.*, 1904, 85, 371) state that they were unable to obtain benzenesulphonphenylchloroamide, which was too unstable to be isolated in a pure state. This

and other similar compounds can, however, easily be obtained if precautions are taken to avoid the presence of catalytic agents which bring about transformation. They are well-crystallised, comparatively stable substances, and show the characteristic behaviour of chloroamino-derivatives. The method of preparation and the properties of benzenesulphonphenylchloroamide and of a number of similar compounds were described.

131. "**Stereoisomeric glucoses and the hydrolysis of glucosidic acetates.**" **By Edward Frankland Armstrong and Paul Seidelin Arup.**

The results obtained on hydrolysing several of the glucosidic acetates by alkali were described and discussed in the light of the evidence recently brought forward regarding the stereoisomeric glucoses. It was shown that the acetyl groups are removed with unequal readiness from the penta-acetates of glucose and galactose and from sucrose octoacetate, and with equal readiness from the tetra-acetates of the methylglucosides and galactosides. Kreman's observation (*Monatsh.*, 1902, 23, 479) that the two isomeric penta-acetates of glucose are hydrolysed at equal rates is confirmed.

132. "**The colouring matter of the flowers of Butea frondosa.**" **By Arthur George Perkin.**

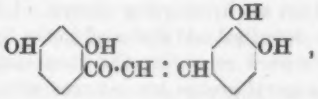
In a former communication (J. J. Hummel and A. G. Perkin, *Proc.*, 1903, 19, 134), it was considered probable that butein from *Butea frondosa* exists in a colourless, as well as in a yellow form. These modifications are, however, distinct substances. The colourless compound now termed *butin*, $C_{15}H_{12}O_5$, crystallising from alcohol in colourless needles and from dilute alcohol in pale yellow needles with $\frac{1}{2}H_2O$, melts at 224—226°. The *triacetyl* compound, $C_{15}H_9O_5(C_2H_3O)_3$, forms colourless leaflets (m. p. 123—125°), and the *benzoyl* compound, $C_{15}H_9O_5(C_7H_5O)_3$, colourless needles (m. p. 155—157°). On fusion with caustic alkali, butin gives resorcinol and protocatechuic acid, and at a lower temperature resacetophenone is also formed. By methylation, two isomeric *methyl ethers*, $C_{15}H_9O_2(OCH_3)_3$, are produced: (*a*) yellow leaflets (m. p. 156—158°) containing a free hydroxyl group, and (*b*) almost colourless, flat needles (m. p. 119—121°).

Butein, $C_{15}H_{12}O_5$, orange-yellow needles (m. p. 213—215°), crystallises from dilute alcohol with $1H_2O$; it is obtained in small quantity together with butin from the plant, and can be prepared from butin by the action of hot dilute caustic alkali or alcoholic potassium acetate; *acetylbutein*, $C_{15}H_8O_5(C_2H_3O)_4$, forms pale yellow needles (m. p

129—131°). On fusion with alkali, butein gives the same decomposition products as butin, and on methylation the same two trimethyl ethers, (*a*) m. p. 156—158°, and (*b*) m. p. 119—121°.

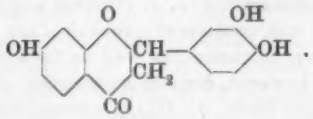
When digested with boiling dilute alcoholic sulphuric acid, butein is partially reconverted into butin, and by digesting the trimethyl compound (m. p. 119—121°), which is really butin methyl ether, with alcoholic potash and water it passes into the butein methyl ether (*a*) (m. p. 156—158°). Again, on digesting butein methyl ether with alcoholic sulphuric acid butin methyl ether is obtained.

Butein has the constitution of a *tetrahydroxybenzylideneacetophenone* (chalkone):



as proved by the synthesis of its trimethyl ether (m. p. 156—158°) by the condensation of veratric aldehyde with resacetophenone monomethyl ether.

Kostanecki and his colleagues (*Ber.*, 1904, **37**, 784) have shown that with dilute sulphuric acid chalkone methyl ethers give the corresponding flavanone compounds, and as both butein and its methyl ether in this way yield butin and its methyl ether respectively, there can be little doubt that butin has the following constitution:



133. "Cyanomaclurin." By Arthur George Perkin.

Cyanomaclurin (*Trans.*, 1895, **67**, 937) which exists in jackwood (*Artocarpus integrifolia*) in conjunction with morin, crystallises from water in the anhydrous form, and is now shown to be isomeric with the catechins, $C_{15}H_{14}O_6$; it forms a *penta-acetyl* compound,

$$C_{15}H_9O_6(C_2H_3O)_5,$$

separating in colourless needles (m. p. 136—138°), a *pentabenzoyl* compound forming colourless prisms (m. p. 171—173°), and the *azobenzene* derivative, $C_{15}H_{12}O_6(C_6H_5N_2)_2$ (m. p. 245—247°), gives an *acetyl* compound melting at 209—210°. On fusion with caustic alkali, cyanomaclurin gives β-resorcylic acid (not cresorcylic acid as previously suggested) and phloroglucinol, and with pine wood and hydrochloric acid it resembles the catechins in giving the phloroglucinol reaction.

With boiling dilute hydrochloric acid, a brown amorphous compound is produced; this is identical in appearance with the so-called fourth anhydride from Gambier catechin, and has the same percentage composition.

Cyanomaclurin thus appears to represent a catechin in which the catechol nucleus is replaced by resorcinol.

134. "The determination of acetyl groups." By Arthur George Perkin.

The substance (approximately 0·5 gram) in 30 c.c. alcohol is distilled with 2 c.c. of sulphuric acid, a little fresh alcohol being added from time to time. The distillate is collected in standard alcoholic potash, and this is boiled in order to saponify the ethyl acetate present, the mixture being subsequently titrated with sulphuric acid. The operation is complete in about an hour and sufficiently accurate for general use. The following results have been obtained:

Acetylalizarin	gave acetic acid	= 37·59.	Theory 37·04.
Acetylquercetin	,,	= 58·44.	,, 58·59.
Acetylpurpurogallin	,,	= 62·40.	,, 61·86.
Acetylcatechin (m. p. 129—130°)	,,	= 60·18.	,, 60·00.
Acetylcatechin (m. p. 158—160°)	,,	= 60·24.	,, 60·00.
Acetylbutin	,,	= 45·60, 45·34.	,, 45·23.

With acetanilide and its homologues reliable results are also obtained, employing, however, 4 c.c. of sulphuric acid, and longer distillation. Thus acetanilide itself gave acetic acid = 44·74 and 44·55 per cent., whereas theory requires 44·44. It has been previously shown that, with alcoholic potassium acetate, acetyl derivatives of the phenols evolve ethyl acetate. This process can be employed for acetyl determinations in some instances, and is still under investigation, but as yet has not been successful in all cases. By this means acetylbutin gave 45·60 (p. 169) and acetylbutein 54 per cent.; in the latter case the theory requires 54·54 per cent.

135. "Note on the catechins." By Arthur George Perkin.

In a previous communication (*Trans.*, 1902, 81, 1160) it was pointed out that whereas Gambier catechu contains a catechin, $C_{15}H_{14}O_6$ (m. p. 175—177°), the pentabenzoyl derivative of which melts at 151—153°, yet a catechin, $C_{15}H_{14}O_6$, which was isolated from *Acacia catechu* melted at 204—205°, and gave a benzoyl compound, melting at

181—183°. It is now found that the acacia catechin gives an acetyl derivative, $C_{15}H_9O_6(C_2H_3O)_5$, forming colourless needles (m. p. 158—160°), and a tetramethyl ether, $C_{15}H_{10}O_2(OCH_3)_4$, separating in colourless prisms (m. p. 152—153°). The corresponding substances from the Gambier catechin (Kostanecki and Tambor, *Ber.*, 1902, **35**, 1867), melt at 129—130° and at 142—143°, respectively. For acacia catechin the name "*acacatechin*" is proposed.

136. "A constituent of Java indigo." By Arthur George Perkin.

Rawson (*J. Soc. Dyers and Colourists*, 1899, **15**, 129) has shown that Java indigo contains a yellow colouring matter. This substance, $C_{15}H_{10}O_6$, forms yellow needles, melts at 276—277°, and gives an acetyl compound, $C_{15}H_6O_6(C_2H_3O)_4$, which separates in colourless needles and melts, when crystallised from methyl alcohol, first at 116—120° and subsequently at 181—182°. The colouring matter is identical with kampherol (*Trans.*, 1902, **81**, 587).

LIST OF FELLOWS.

As the List of Fellows for 1904 is now in active preparation, no change of address received after July 30th can be included in it.

THE LIBRARY.

The Library will be closed for Stock-taking from **Monday, August 8th**, until **Saturday, August 20th**, 1904, inclusive.

Fellows are particularly requested to return all books belonging to the Library **not later than Wednesday, August 3rd.**

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Issued 12/11/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 284.

The following are abstracts of papers received during the vacation and published or passed for publication in the *Transactions*.

137. "The action of chromyl chloride on stilbene, styrene, and phenanthrene." By George Gerald Henderson and Thomas Gray.

Each of the hydrocarbons, stilbene, styrene, and phenanthrene, when treated with chromyl chloride in carbon disulphide solution, yields a solid, brown additive compound. These solids are decomposed by water, and oxidation products of the hydrocarbons are liberated. Stilbene is oxidised to benzil, and, with partial decomposition, to benzophenone and benzaldehyde. Styrene yields benzaldehyde as the chief product, together with a trace of phenylacetaldehyde and a small amount of a chlorinated compound. The sole product obtained from phenanthrene was phenanthraquinone.

138. "The stereoisomeric tetramethyl methylglucosides and tetramethyl glucose." By Thomas Purdie and James Colquhoun Irvine.

The pentamethyl glucose (m. p. 42—43°) obtained from tetramethylglucose, either by the silver oxide method of alkylation or by the action of methyl alcohol containing hydrogen chloride (*Trans.*, 1903, 83, 1035), proves to be *tetramethyl-β-methylglucoside*; the stereoisomeric liquid α-glucoside is produced simultaneously, but in much

smaller proportion. The β-glucoside is characterised by its lævorotatory power, its more rapid hydrolysis by hydrochloric acid, and its susceptibility to the hydrolytic action of emulsin.

In aqueous solution, tetramethyl glucose, like glucose itself, exhibits phenomena of multirotation. The α-form (m. p. 88—89°; $[\alpha]_D^{20°}$ +100·8°) is obtained by repeated crystallisation of the crude aldose from petroleum; the β-form (Tanret's γ-form), or at least a mixture containing a large excess of it ($[\alpha]_D^{20°}$ 73·1°), is produced by heating the α-form above its melting point. The modification, which is stable in solution ($[\alpha]_D^{20°}$ 83·3°), is apparently a mixture of the two dynamic isomerides. In the solid state, the β-isomeride reverts to the α-form.

Multirotation was also observed in benzene and carbon tetrachloride, and therefore neither ionisation nor the formation of hydrates or compounds of the acetal class is essential for the occurrence of this phenomenon.

139. "The alkylation of galactose." By James Colquhoun Irvine and Adam Cameron.

The silver oxide method of alkylation, when applied to α-methylgalactoside, gives rise to tetramethyl α-methylgalactoside, a colourless, refractive liquid (b. p. 136—137°/11 mm., $[\alpha]_D^{20°}$ of the pure liquid is +105·7°, and in aqueous solution $[\alpha]_D^{20°}$ is +143·4°). Hydrolysis with hot dilute hydrochloric acid leads to the production of tetramethyl galactose, a colourless, refractive syrup (b. p. 172°/13 mm.). After distillation, the alkylated sugar displays multirotation, not only in water, but also in alcohol and benzene, the permanent values for these three solvents being +109·5°, 62·6°, 90·0° respectively. In other respects, also, the behaviour of the compound supports the view that it has an oxidic structure.

When the substance is either heated with methyl alcohol and hydrochloric acid or treated with silver oxide and methyl iodide, the stereoisomeric tetramethyl α- and β-methylgalactosides are produced, the latter method giving a large excess of the β-compound, whilst the former yields a greater proportion of the α-isomeride. The crystalline β-form (m. p. 44—45°) is much more readily hydrolysed than its isomeride, either by dilute acids or by emulsin.

140. "A method for the rapid ultimate analysis of certain organic compounds." By John Norman Collie.

The method consists in burning the substance in a known volume of oxygen, noticing any change in the volume of the gas, and then, by

absorbing the carbon dioxide produced, data sufficient for the calculation of the percentage amounts of carbon and hydrogen are obtained.

Only those substances can be estimated which are not appreciably volatile in a vacuum, and which contain only carbon and hydrogen or carbon, hydrogen, and oxygen. The time required for an analysis is only about an hour; the amount of substance used can be reduced to nearly one-tenth of that ordinarily employed, and as the measurements depend on volumes of gases the method is very accurate.

141. "The comparative nitrifying power of soils." By Sydney Francis Ashby.

The method devised for comparing quantitatively the power of cultivated soils to convert their ammonia into nitrites and nitrates has justified itself by :—

(1) Yielding samples giving reasonably similar nitrifying power from different parts of the same field.

(2) Causing equal seedings from the same sample to show similar nitrifying power.

(3) Minimising loss of nitrogen by volatilisation of ammonia and denitrification during incubation.

(4) Limiting the incubation period to about 30 days.

(5) Showing a nitrifying power of the soils tested which corresponds with their fertility as gauged from manuring and crop production.

142. "The action of organic bases on olefinic ketonic compounds." By Siegfried Ruhemann and Edwin Roy Watson.

Benzylideneacetylacetone readily unites with *m*-toluidine, *p*-toluidine, *m*-chloroaniline, *p*-chloroaniline, β-naphthylamine, and piperidine, but it does not combine with *o*-toluidine, α-naphthylamine, or tetrahydroquinoline.

Piperidinobenzylacetylacetone, $C_6H_5 \cdot CH(NC_5H_{10}) \cdot CH(CO \cdot CH_3)_2$, is stable in a dry atmosphere, but in the presence of moisture it gradually decomposes with the formation of benzylidenebisacetylacetone, benzaldehyde, and piperidine.

The production of benzylidenebisacetylacetone and similar compounds from benzaldehyde and ketonic compounds is therefore preceded by the formation of additive compounds of piperidine with olefinic ketonic compounds. This view is supported by the fact that benzylideneacetylacetone, which combines with piperidine, also condenses with acetylacetone in the presence of the base to form benzylidenebisacetylacetone, whilst no such reaction takes place if tetrahydroquinoline, which does not form an additive compound with the olefinic ketone, is used instead of piperidine.

With phenylhydrazine, dibenzylideneacetone forms the phenylhydrazone, $(C_6H_5CH{:}CH)_2C{:}N{\cdot}NH{\cdot}C_6H_5$, and not an additive compound; with ammonia, it yields a mixture of substances from which has been isolated the compound having the formula $C_{34}H_{35}N_3$.

Benzylideneacetophenone dibromide, when condensed with ammonia, yields aminobenzylideneacetophenone, $C_6H_5{\cdot}C(NH_2){:}CH{\cdot}CO{\cdot}C_6H_5$, it therefore follows that the corresponding compound obtained by Wieland (*Ber.*, 1894, **27**, 1150) from ammonia and *p*-nitrobenzylideneacetophenone dibromide is also unimolecular.

143. "Halides of the acridines and naphthacridines." By Alfred Senier and Percy Corlett Austin.

The halogens combine directly with the acridines, forming a series of well-defined, crystalline compounds, which are sparingly soluble in organic media, and are obtained by mixing the reagents either alone or in a suitable solvent. The products, which have characteristic colours, are unstable, especially in presence of water. The fluorescence, when in solution, which is so marked a character of acridines generally, and which depends on the presence of the acridine "fluorophore," is absent, except in three instances.

That these compounds are not substitution derivatives follows from their instability, the small number of halogen atoms which they contain, and the fact that no acridone is formed when they are treated with water or alkalis. They are therefore additive compounds, namely, halides. Moreover, the addition takes place in the acridine ring, for, were it otherwise, monadic atoms would be added only in pairs, which, however, is not the case, and a higher number would combine owing to the disruption of the centric benzene linkings.

Adopting this view, two formulæ are possible for the dihalides. The first, which is of the type of the dihydrides or dihydroacridines (Bernthsen and Bender, *Ber.*, 1883, **18**, 1802), is suggested for the non-fluorescent dihalides, and the second, corresponding with the acridinium salts, alkylhalides, and alkylhydroxides, is employed for the dihalides which exhibit fluorescence. In accordance with the foregoing hypothesis, the tetrahalides should have formulæ of the former non-fluorescent type, and acridine tetrabromide, the only tetrahalide described, was found to be non-fluorescent.

Those compounds which contain one halogen atom combined with one and three molecular proportions of base respectively are regarded as being products intermediate between the bases and the dihalides, in the one case, and the dihalides and tetrahalides in the other, and to these products dimolecular formulæ are assigned.

144. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part II. Cyanohydrins regarded as complex acids." By Arthur Lapworth.

Under certain conditions, an aqueous solution of potassium cyanide readily dissolves benzaldehyde and camphorquinone. From the resulting liquids, crystalline additive products having approximately the compositions $C_7H_6O,KCN,2\frac{1}{2}H_2O$ and $C_{10}H_{14}O_2,KCN,3H_2O$ have been isolated. These substances behave as salts of the corresponding cyanohydrins, which are probably much feebler acids than hydrocyanic acid itself.

145. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part III. Action of potassium cyanide on mesityl oxide." By Arthur Lapworth.

It was shown that when mesityl oxide is heated with potassium cyanide dissolved in dilute alcohol, hydrogen cyanide is first assumed at the ethylenic carbon linking, and that the potassium hydroxide which is simultaneously produced converts the product into mesitonic acid; more prolonged heating results in the formation of mesitylic acid, which necessitates the addition of a second molecule of hydrogen cyanide in this case to the carbonyl group, and the subsequent hydrolysis of the product.

146. "6-Aminocoumarin." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

6-Aminocoumarin, although resembling the naphthylamines in containing two unsaturated rings, nevertheless behaves towards diazonium salts like a para-substituted benzenoid amine, giving rise to stable diazoamino-derivatives.

This base and its mono- and di-alkylated compounds and the corresponding hydrazine and diazocyanide are all coloured substances, whereas the salts of these bases, the acyl derivatives of the primary and secondary amines, the nitrosoamines of the monoalkyl derivatives, the diazonium salts of the parent base and its quaternary bromides and iodides are colourless.

147. "Studies in asymmetric synthesis. I. Reduction of menthyl benzoylformate. II. Action of magnesium alkyl haloids on menthyl benzoylformate." By Alexander McKenzie.

When *l*-menthyl *dl*-mandelate is hydrolysed by an amount of potassium hydroxide insufficient for complete hydrolysis, an optically active mandelic acid is invariably obtained from the potassium salt thus formed. The mixture of esters remaining after this partial hydrolysis, when completely hydrolysed, yields mandelic acid which is either optically active or inactive, according to the experimental conditions. In the complete hydrolysis, by potassium hydroxide, of a mixture of *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate containing an excess of either of those esters, racemisation phenomena are observed.

On reducing menthyl benzoylformate to menthyl mandelate and hydrolysing the latter, the mandelic acid obtained was inactive. But it does not follow from this result that equal amounts of *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate were present in the product obtained by the reduction of menthyl benzoylformate, since, even if unequal amounts had been present, the mandelic acid obtained might still have been inactive owing to the racemising effect of the hydrolysing alkali.

Further investigation showed that a slight excess of *l*-menthyl *l*-mandelate was present in the reduction product, which, however, on hydrolysis, yielded *r*-mandelic acid.

When menthyl benzoylformate, $PhCO\cdot CO_2\cdot C_{10}H_{19}$, is acted on by magnesium methyl iodide and the magnesium addition compound then decomposed by water and dilute acid, a new asymmetric carbon atom is produced. In this instance, no racemising effects are observed on hydrolysing the product with alkali, since an optically active potassium salt is present in solution after the complete removal of the *l*-menthol, and this salt yields an optically active phenylmethylglycollic acid, $CMePh(OH)\cdot CO_2H$. An optically active phenylethylglycollic acid was also obtained in a similar manner.

That the optical activity exhibited by phenylmethylglycollic and phenylethylglycollic acids, prepared by Grignard's reaction, was actually due to their asymmetric synthesis was shown by preparing diphenylglycollic (benzilic) acid from menthyl benzoylformate and magnesium phenyl bromide. In this case, where a new asymmetric carbon atom was not produced, the resulting acid was inactive.

148. "The relation of position isomerism to optical activity. II. The rotation of the menthyl esters of the isomeric chlorobromobenzoic acids." By Julius Berend Cohen and Henry Stanley Raper.

The authors have extended the research of Briggs and Cohen on the relation of position isomerism to the rotations of the menthyl esters of the six dichlorobenzoic acids (*Trans.*, 1903, 83, 1213) by preparing and examining the menthyl esters of the ten isomeric chlorobromobenzoic acids.

The molecular rotations of these esters agree in a very satisfactory way with those of the dichlorobenzoic esters.

The greatest effect in decreasing the rotation is produced when the halogen enters the ortho-position with respect to the ester group; the least when both halogens are in the meta-position. The mean order of magnitude, beginning with the ester of lowest rotation, is as follows:

2:6; 2:3; 2:5; 2:4; 3:4; 3:5; phenyl,

which is precisely the order of rotation of the dichloro-esters.

When the chlorine is nearer to the ester group than the bromine, a greater depression in the rotation is produced than by the reverse arrangement. Moreover, when the chlorine occupies the ortho-position to the ester group, the rotation is lower than that of the corresponding dichloro-ester. The general effect of bromine is to influence the rotation less than the chlorine—a result which seems to follow from the effect of the monohalogen esters.

The great contrast afforded by the two symmetrical compounds of both series, namely, the 3:5- and 2:6-esters, is not a little remarkable, and these isomerides may be regarded as the first and last terms of a series in which the 2:6-compounds have a high melting point and low rotation, whilst the 3:5-isomerides have a low melting-point, low density, and high rotation.

149. "The relation of position isomerism to optical activity. III. The rotation of the menthyl esters of the isomeric iodobenzoic acids." By Julius Berend Cohen and Henry Stanley Raper.

In a former communication (Cohen and Briggs, *Trans.*, 1903, 83, 1216), the rotations of the menthyl esters of the three monochlorobenzoic acids were given and compared with the constants obtained for the monobromobenzoic esters by Tschugaeff. The authors have now determined the constants for the menthyl esters of the three iodobenzoic acids.

150. "The chlorination of the trichlorotoluenes in presence of the aluminium-mercury couple. The constitution of the tetrachlorotoluenes. Part V." By Julius Berend Cohen and Henry Drysdale Dakin.

In previous papers (Part III., *Trans.*, 1901, **79**, 1111; Part IV., *Trans.*, 1902, **81**, 1325), the authors have traced the progressive chlorination of toluene as far as the formation of the trichlorotoluenes. The products formed on introducing a fourth chlorine atom into each of the six trichlorotoluenes have now been investigated.

On chlorinating 3 : 4 : 5-trichlorotoluene at 0°, the chlorine enters the side-chain instead of the nucleus.

Although there appears to be no general law determining the position of the fourth entrant chlorine atom, yet there exists a remarkable agreement between the positions taken by the entrant chlorine atoms and nitro-groups when the first two chlorine atoms have been introduced into either benzene or toluene. Whatever the ultimate explanation may be, it is clear that after the first two chlorine atoms have been introduced into benzene and toluene the special rules which usually govern substitution are wholly or in part set aside in favour of a more general law which includes both the substituent chlorine atom and also the nitro-group.

151. "The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds. Part I. Alkyl haloids." By Arthur Slator.

The reactions between sodium thiosulphate and methyl, ethyl, and ethylene haloids have been investigated in dilute solution and shown to be in most cases bimolecular, thus: $CR_3I + S_2O_3'' = CR_3S_2O_3' + I'$. Water was used as a solvent whenever possible, but in a few cases a mixture of this liquid and alcohol had to be employed.

The rate of reaction is approximately trebled for a rise of 10°. The velocity-coefficients may be used to compare the reactivities of these haloids. With two of the compounds (C_2H_4ICl, C_2H_4BrCl), the velocity of the reaction with excess of thiosulphate is independent of this excess and the reaction is therefore unimolecular. To explain this result, it is suggested that the haloids are capable of existing in two tautomeric forms, and that the measurable reaction represents the change of one form into the other.

152. "Note on methyl fluoride." By John Norman Collie.

Methyl fluoride under 2 mm. pressure, when contained in a vacuum tube having aluminium electrodes and subjected to the spark from an

induction coil, gives a bluish-green colour. The spectrum, however, rapidly changes, and the characteristic lines of hydrogen make their appearance. When sparked under the ordinary pressure, the gas is almost immediately decomposed in the following manner: $4CH_3F = 4C + 4H_2 + 2H_2F_2$. In glass tubes, a secondary change occurs; the silicon fluoride formed by the action of the hydrogen fluoride on the glass is reduced by the hydrogen, and silicon is deposited: $SiF_4 + 2H_2 = 2H_2F_2 + Si$.

153. "Acetylenic ketones." By Edwin Roy Watson.

The action of various bases on bromobenzylideneacetophenone, $C_6H_5\cdot CBr{:}CH\cdot CO\cdot C_6H_5$, has been investigated in the hope that a molecule of hydrogen bromide might thereby be eliminated from this compound (compare Ruhemann and Watson, *Trans.*, 1904, 85, 457). The action of solid powdered potash gives rise to phenylacetylene, potassium benzoate, and potassium bromide.

The action of alcoholic ammonia gives rise to aminobenzylideneacetophenone, $C_6H_5\cdot C(NH_2){:}CH\cdot CO\cdot C_6H_5$, and by the action of piperidine two compounds, dipiperidinobenzylacetophenone and piperidinobenzylideneacetophenone, are produced. Strong bases replace the bromine atom in bromobenzylideneacetophenone by an amino- or substituted amino-group.

Phenylpropiolyl chloride reacts readily with anisole to produce the expected acetylenic ketone, methoxybenzoylphenylacetylene. On substituting benzene for anisole the simple reaction no longer occurs, but several substances are produced, including a hydrocarbon having the empirical formula $C_{14}H_{12}$.

Methoxybenzoylphenylacetylene and piperidine yield piperidinomethoxybenzoylstyrene, $C_6H_5\cdot C(NC_5H_{10}){:}CH\cdot CO\cdot C_6H_4\cdot O\cdot CH_3$, whilst the action of hydroxylamine gives rise to 1-phenyl-3-methoxyphenyl-*iso*oxazole.

Benzoylphenylacetylene yields the phenylhydrazone,

$$C_6H_5\cdot C{:}C\cdot C(:N\cdot NH\cdot C_6H_5)\cdot C_6H_5,$$

and the anilinobenzoylstyrene, $C_6H_5\cdot C(NH\cdot C_6H_5){:}CH\cdot CO\cdot C_6H_5$, when treated with phenylhydrazine and aniline respectively.

154. "Note on bergamot oil and other oils of the citrus series." By Herbert Edward Burgess and Theodore Henry Page.

Acetic acid, octylene, pinene, camphene, and limene have been identified as constituents of a specimen of pure oil of bergamot. The pungency of the first fractions of this oil on distillation is accounted

for by the acetic acid, which was also found in smaller quantities in lemon oil and is probably present in the other oils of this series.

The octylene found in lemon oil was identical with that in bergamot oil, for both gave butyric acid on oxidation with potassium permanganate. It is probably a normal constituent of the citrus oils. A second phenylurethane isolated from the terpineol fraction of distilled oil of limes melts at 132°, is more soluble than that obtained from ordinary terpineol, crystallises in tufts of needles, and gives on hydrolysis an oil with an intense odour of distilled oil of limes.

155. "The resolution of externally compensated dihydro-α-methylindole." By William Jackson Pope and George Clarke, jun.

On crystallising externally compensated dihydro-α-methylindole with *d*-bromocamphorsulphonic acid, *l*-dihydro-α-methylindole *d*-bromocamphorsulphonate, $C_9H_{11}N,C_{10}H_{14}BrO\cdot SO_3H$, first separates, and on purification crystallises in needles (m. p. 179·5—180·5°; $[M]_D + 278°$ in aqueous solution). With caustic soda, it yields *l*-dihydro-α-methylindole, which is obtained as a colourless oil (b. p. 228—229°; $[\alpha]_D - 13·61°$ in a 1 dcm. tube). The base is dextrorotatory in ethyl alcohol and benzene solutions, but lævorotatory in ethereal solution.

A more sparingly soluble dihydro-α-methylindole *d*-bromocamphorsulphonate (m. p. 124—125°) accompanies the above salt, but, although it has the low molecular rotatory power of $[M]_D + 242·6°$ in aqueous solution, corresponding with the presence of a basic ion of $[M]_D - 30°$, this salt yields inactive base and inactive benzoyl and acetyl derivatives.

On adding caustic soda to the final mother liquors obtained during the resolution, impure *d*-dihydro-α-methylindole separates, but was not obtained free from the lævo-isomeride; its benzoyl and acetyl derivatives were, however, prepared in a state of purity, and have properties corresponding with those of their optical antipodes.

156. "The vapour pressures of sulphuric acid solutions and the molecular condition of sulphuric acid in concentrated solution." By Bryce Chudleigh Burt.

The vapour pressures of sulphuric acid solutions of various concentrations (from 25 to 95 per cent. H_2SO_4) have been determined by an ebullioscopic method. The values so obtained lie on smooth curves when plotted against temperature and concentration. The molecular weight has been calculated from Raoult's corrected formula:

$$m = M.\frac{g}{G}.\frac{p'}{p - p'},$$

where m = molecular weight of solute; M = molecular weight of solvent in the gaseous state; g = weight of solute; G = weight of solvent; p = vapour pressure of pure solvent; p' = vapour pressure of solution. The values for m obtained vary over very wide limits, increasing with rise of temperature and decreasing with increase in concentration. The different values do not lie on smooth curves when plotted against temperature and concentration.

These abnormalities can only be explained by supposing that combination occurs between the solvent and solute with the formation of complex molecules, the formation of such complexes being favoured by an increase in concentration but not by a rise in temperature.

157. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part IV. Addition of hydrogen cyanide to benzylideneacetophenone." By Archie Cecil Osborn Hann and Arthur Lapworth.

The addition of hydrogen cyanide to benzylideneacetophenone takes place only in presence of a considerable quantity of potassium cyanide, and the failure of Rupe and Schneide (*Ber.*, 1895, **28**, 957) to bring about the addition process is thus explained. When the solution is but feebly alkaline, the product is β-benzoyl-α-phenylpropionitrile, $CHPh(CN)\cdot CH_2\cdot COPh$, but in presence of alkali the latter condenses with unaltered benzylideneacetophenone to yield the compound $C_{31}H_{23}ON$, which Rupe and Schneide obtained in small quantities.

The *oxime*, $CHPh(CO_2H)\cdot CH_2\cdot CPh{:}N\cdot OH$, when warmed with sulphuric acid, undergoes the Beckmann change, yielding phenylsuccinic acid and aniline, by which reaction the constitution of the ketonic acid is established.

By means of the quinine salt, β-benzoyl-α-phenylpropionic acid was resolved into its optical isomerides; the *lævo*-acid, melting at 176—178° in 6 per cent. ethyl acetate solution, had $[\alpha]_D - 157{\cdot}57°$, whilst the *dextro*-acid had $[\alpha]_D + 157{\cdot}3°$.

158. "The bromination of silver cyanate." By George Dean.

Silver cyanate, when treated with an equivalent weight of bromine in a sealed tube, yielded a yellow product, AgCNOBr. The substance, which did not darken on exposure to light, gave off bromine when heated above 70°. At 300—400°, the bromine evolved from the substance was accompanied by a thick sublimate of cyanogen bromide. The substance dissociated under 10—20 mm. pressure. Water acts on the compound, yielding silver bromide, cyanuric acid, carbon dioxide, and nitrogen; hydrochloric acid gives rise to a mixture of silver chloride

and bromide, whilst cyanogen chloride, bromine, and oxygen are eliminated. The compound oxidises alcohol to acetaldehyde. When the cyanate was brominated at a lower temperature, much more halogen was absorbed; the product, however, was readily decomposed in a current of air, leaving the less brominated compound.

159. "The decomposition of chloral hydrate by sodium hydroxide and by certain salts." Emil Alphonse Werner.

It is shown that the quantity of chloral hydrate decomposed by sodium hydroxide is a function of the temperature, for one molecular proportion of this alkali is capable of decomposing from one to four molecular proportions of the hydrate with production of chloroform, sodium formate, and free formic acid. Sodium acetate and similar salts are also capable of decomposing the hydrate with the production of formic acid. Water and dilute acids do not decompose chloral hydrate in this manner.

Two alternative theories are put forward to explain the decomposition. Firstly, it is assumed that a sodium derivative, $CCl_3 \cdot CH(ONa) \cdot OH$, formed on adding the alkali or salt, is immediately decomposed into chloroform and sodium formate. The decomposition of relatively large proportions of the hydrate by sodium hydroxide is easily explained in this way.

Secondly, the production of "nascent" carbon monoxide, $>C:O$, as distinct from ClO, is suggested, this hypothetical substance then uniting with water to give formic acid.

160. "Contributions to the history of glyoxylic acid." By Heinrich Debus.

Two views still prevail with regard to the formula of glyoxylic acid: some chemists represent its composition by the formula $C_2H_2O_3,H_2O$, whilst others prefer the expression $C_2H_4O_4$. The author, after discussing the arguments in favour of each formula, comes to the conclusion that the formula $C_2H_2O_3,H_2O$ is more in harmony with the properties of glyoxylic acid than the other.

Some basic salts of glyoxylic acid are described which readily decompose into the corresponding glycollates and oxalates.

161. "The colouring matters of the stilbene group. I." By Arthur George Green.

The colouring matters of the stilbene class cannot have the simple structure assigned to them either by O. Fischer and Hepp or by Bender

and Schultz. Apart from the general improbability that substances so constituted would have dyeing properties, the following facts indicate that they have a more complex structure :—

(1) Colouring matters can be obtained from *p*-nitrotoluenesulphonic acid by condensation with alkalis under suitable conditions, which, although having the general characteristics of Curcumine S or Direct Yellow, contain aldehydic groups in addition to the stilbene group.

(2) Stilbene dyes of mixed type can be obtained by condensing dinitrostilbenedisulphonic acid with aromatic amines under the influence of alkalis.

(3) Curcumine or Direct Yellow does not give rise on oxidation to dinitrostilbenedisulphonic acid, but furnishes a yellow dye of greener shade which is very similar to the first product of the alkaline reduction of dinitrostilbenedisulphonic acid.

The author has endeavoured to elucidate the constitution of the crimson-red compound which invariably precedes the formation of the stilbene colouring matter and is evidently the first phase of the condensation. The fact that this substance, on oxidation with hypochlorite, gives dinitrostilbenedisulphonic acid (Green and Wahl, *Ber.*, 1897, **30**, 3097) and is again regenerated from this acid on reduction, supported by a study of its phenyl ester and the analogous chloro-compound (compare next abstract), leads to the view that the crimson-red intermediate compound is a nitroso-stilbene or stilbene nitrolic acid having a quinonoid structure in alkaline solution.

162. "The colouring matters of the stilbene group. II." By Arthur George Green, Fred Scholefield, and Fred Marsden.

In order to elucidate the constitution of the crimson-red compound obtained on heating *p*-nitrotoluenesulphonic acid with caustic alkalis, and which forms the first phase of the stilbene condensation, the authors have investigated the behaviour of the corresponding phenyl ester, $C_6H_3(CH_3)(SO_3C_6H_5)(NO_2)[1:2:4]$, and chloro-compound, $C_6H_3(CH_3)Cl(NO_2)[1:2:4]$. The first of these compounds, in alcoholic solution, gives, on adding caustic soda, an intense bright blue coloration even in the cold ; the second gives a reddish-violet coloration at 20—30°.

It being found impracticable to isolate these coloured substances on account of their extreme instability, their behaviour on oxidation was studied. They are rapidly decolorised both by sodium hypochlorite and by air, and give rise to derivatives of dinitrostilbene. From the phenyl ester, a mixture of the *trans*- and *cis*-phenyl dinitrostilbenedisulphonates was produced. The same two compounds were also obtained from Green and Wahl's dinitrostilbenedisulphonic acid by conversion

into the sulphonic chloride and treatment with sodium phenoxide. This fact serves to confirm the constitution assigned above, and also shows that the dinitrostilbenedisulphonic acid, and probably also the crimson-red intermediate compound and the stilbene colouring matters generally, must consist of mixtures of *trans*- and *cis*-isomerides.

The reddish-violet intermediate compound from *o*-chloro-*p*-nitrotoluene, on oxidation with air or sodium hypochlorite, yielded a mixture of *trans*- and *cis*-dichlorodinitrostilbenes; the yield of the two isomerides being nearly theoretical, the formation of a third substance is excluded and a simple connection between the coloured intermediate compound and the respective dinitrostilbene derivative is indicated. This is further supported by the fact that these dinitrostilbene derivatives are readily reconverted by alkaline reducing agents, such as phenylhydrazine and caustic soda, into the blue and reddish-violet compounds from which they are obtained. The authors are thus led to assign to the latter the structure of nitrosostilbenes or stilbene nitrolic acids.

163. "Researches on chromorganic acids: the behaviour of chromic hydroxide towards oxalic acid and certain other organic acids." By Emil Alphonse Werner.

An aqueous solution of oxalic acid, when saturated with chromic hydroxide, yields a deep purplish-red liquid, which, on evaporation, leaves a dark green residue, appearing almost-black by reflected light. This compound has the properties of a true chromoxalic acid, $H_5Cr_4(C_2O_4)_6(OH)_5,4H_2O$, and yields an ammonium salt, $(NH_4)_5Cr_4(C_2O_4)_6(OH)_5,2H_2O$.

Whilst thoroughly washed chromic hydroxide is readily dissolved by oxalic acid in the proportion required by the formula $Cr_2(C_2O_4)_3$, this is not the case with other related organic acids. Under similar conditions, malonic acid dissolves approximately 50 per cent. of the calculated amount, whereas, with succinic acid, the interaction is inappreciable. A chromomalonic acid, having the formula $H_5Cr_4(C_3H_2O_4)_6(OH)_5,6H_2O$, analogous to the chromoxalic acid, was obtained, and also a chromomalonate, $K_2Cr_2(C_3H_2O_4)_4,10H_2O$, forming dark purplish-red crystals, the analogue of Croft's red chromoxalate.

The proportion of chromic hydroxide dissolved by malic, tartaric, tricarballylic, citric, glycollic, and lactic acids under the conditions described is relatively small, varying from a minimum of 12 per cent. (malic acid) to a maximum of 27 per cent. (lactic acid). In all these cases, chromorganic acids are produced, having, in general, properties resembling those of chromoxalic acid. With tartaric acid, a saline chromium tartrate, $Cr_2(C_4H_4O_6)_3$, is also formed. When the red salt, $K_2Cr_2(C_2O_4)_4,10H_2O$, is boiled in aqueous solution with 2 mols. of

potassium oxalate, the blue chromoxalate, $K_6Cr_2(C_2O_4)_6,6H_2O$, is produced; a similar result is brought about by other salts, such as potassium acetate, malonate, or succinate, and so far no chromium compound containing two different acid groups has been obtained.

A well-defined potassium boro-oxalate, $K_2(Bo)_2(C_2O_4)_2,3H_2O$, which is readily obtained by boiling solutions of potassium metaborate and oxalic acid or boric acid and potassium hydrogen oxalate is described. A similar compound is not formed with malonic or succinic acid.

164. "The effect of colloidal platinum on mixtures of Caro's persulphuric acid with hydrogen peroxide." By Thomas Slater Price and John Albert Newton Friend.

Although solutions of hydrogen peroxide and Caro's acid have no appreciable action on each other, the addition of colloidal platinum causes interaction, oxygen being evolved, according to the equation $H_2SO_5 + H_2O_2 = H_2SO_4 + H_2O + O_2$, or $H_2S_2O_9 + 2H_2O_2 = 2H_2SO_4 + H_2O + 2O_2$. The rate of evolution of oxygen gives a measure of the velocity of the reaction; titration methods cannot be used, since there are no accurate methods of estimating hydrogen peroxide and Caro's acid in the presence of each other. It was found that, as long as the platinum was not precipitated out of the solution, the velocity constants, whether of the second or the third order (corresponding with the above equations), continually increased. This increase is considered to be due to two causes: (1) the gradual increase in the reactivity of the platinum during the reaction; (2) the independent and concurrent decomposition of the hydrogen peroxide and Caro's acid respectively. In some cases, the velocity curve was a straight line.

The effect of varying the concentration of the platinum was also studied, but no definite connection between concentration and velocity could be traced, except that a diminution in velocity was associated with a decrease in concentration of the platinum. In alkaline solutions, the results obtained were indefinite, since interaction takes place in the absence of platinum and the velocity seems to depend on the rate of stirring.

165. "The acylation of amides." By Arthur Walsh Titherley.

The conversion of a primary into a secondary amide and a secondary into a tertiary amide cannot, in general, be effected by treatment with acyl chlorides and anhydrides, but by first replacing the hydrogen of the $-CO\cdot NH_2$ or $-CO\cdot NH\cdot CO-$ group by sodium; the resulting sodium acylamide reacts usually with considerable energy with acyl chlorides

or, preferably, anhydrides, yielding acylated derivatives. Sodium benzamide and benzoic anhydride, for example, yield sodium dibenzamide and benzoate. At the same time, a tertiary amide (tribenzamide) is formed owing to the interaction of a portion of the sodium dibenzamide and benzoic anhydride.

Although the action is normal in the aromatic and aliphatic series respectively, abnormal results are obtained on attempting to apply the method to the synthesis of mixed aliphatic aromatic secondary amides. Thus, neither sodium acetamide and benzoic anhydride nor sodium benzamide and acetic anhydride yield the expected acetylbenzamide in appreciable quantity, the main product of either of these condensations being sodium dibenzamide.

Cyclic anhydrides appear to behave normally. Thus, succinic anhydride and sodium benzamide give rise to *benzoylsuccinamic acid* (needles, m. p. 180°) and s-*dibenzoylsuccinamide* (m. p. 211°).

A further application of sodium acylamides for the purpose of acylation is based on their condensation with esters (*Trans.*, 1902, **81**, 1520), but the condensation is abnormal with esters and sodium acylamides which contain the groups $-CH_2 \cdot CO_2Et$ and $-CH_2 \cdot CO \cdot NHNa$ respectively. Methyl oxalate yields the disodium derivative of dibenzoyloxamide, but benzoyloxalimide, which was also anticipated, is not produced.

s-*Dibenzoyloxamide* (m. p. 227°) is readily soluble in sodium hydroxide, but the solution readily undergoes hydrolysis, forming benzamide and sodium oxalate. Ethyl succinate and sodium benzamide readily react, but do not yield either ethyl benzoyl succinamate, dibenzoylsuccinamide, or benzoylsuccinimide; the chief products are sodium succinimide and ethyl benzoate.

A very convenient process for acylating amides direct consists in treating directly with the acyl chloride the amide dissolved in pyridine (compare Freundler, *Compt. rend.*, 1902, **136**, 1553; 1903, **137**, 712—714). The method is limited in the same sense as the sodium acylamide anhydride method, since in this case also aromatic acyl radicles tend to displace aliphatic groups; hence it is impossible to prepare acetylbenzamide from benzoyl chloride and a pyridine solution of acetamide. That the method may be applied to the acylation of secondary as well as primary amides is shown by the fact that dibenzamide when subjected to this process yields 50 per cent. of tribenzamide.

Benzoylsuccinimide (m. p. 129—130°) is readily obtained by the action of benzoyl chloride on a pyridine solution of succinimide.

166. "The composition of beryl." By James Holms Pollok.

The irregular results obtained on the analysis of compounds of glucina, prepared from various samples of the oxide, suggested that there was something in the composition of the beryl that had so far been overlooked.

The glucina employed was extracted from Limoges beryl during a previous research, and was known to give too high an equivalent, although analysis failed to indicate the presence of aluminium or any other base. This glucina was fractionated by crystallisation of the sulphate, by solution in ammonium carbonate, and by precipitation from hydrofluoric acid solution by potassium hydrogen fluoride. The glucina was recovered from the various fractions, converted into anhydrous chloride, and the various specimens of this salt analysed. In certain fractions, a progressive rise in the equivalent of the base was observed, giving figures ranging from 4·77 to 8·17.

Samples of glucinum chloride were then fractionated by distillation, the most volatile and least volatile portions being analysed separately. Three samples of the most volatile portions yielded equivalents of 9·08, 10·81, and 11·29.

Other fractions obtained by collecting the chloride that was first formed, apart from that which distilled over later, gave, on analysis, equivalents of 12·30, 14·80, and 18·74.

Only a small quantity of the chloride with the highest equivalent was obtained; the most careful analysis failed to detect in it the presence of aluminium, iron, or any other element, the sample having the chemical properties of glucinum only.

A spectroscopic examination of the various specimens with high equivalents showed that certain lines, only faintly visible in ordinary samples of glucina, became steadily stronger as the equivalent increased, and the known lines of glucinum became somewhat fainter.

These results indicate that beryl contains a new element having in the main the chemical properties of glucinum, but a much higher equivalent; its chloride is more volatile and more readily formed than that of glucinum, and the oxide is not so readily precipitated from a hydrofluoric acid solution by potassium hydrogen fluoride.

Thursday, November 3rd, 1904. Prof. W. A. TILDEN, D.Sc., F.R.S, President, in the Chair.

Messrs. C. R. Beck, J. H. Johnston, R. Lessing, J. Marsh, and H. S. Shelton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Walter Henry Bentley, B.A., 18, Oaten Hill, Canterbury.
John Wyclif Black, 20, Mardale Crescent, Edinburgh.
Thomas Story Busher, B.A., Queen's College, Oxford.
Lawrence Caldecott, 47, Woburn Place, Russell Square, W.C.
Robert John Caldwell, B.Sc., A.C.G.I., 49, Merritt Road, Crofton Park, S.E.
Peter Skinner Clark, M.B., Ch.M., Cape Town, Cape Colony, South Africa.
Frederick Clarkson-Harold, 10, Fea's Terrace, Longford, Ireland.
Robert Cornthwaite, Agricultural Laboratory, Halifax.
William Crabb, B.Sc., The Grammar School, Penistone, Yorks.
James Edward Cunningham, A.R.C.S., 21, Blenheim Gardens, Willesden Green, N.W.
Harold Deane, B.Sc., 34, Drakefield Road, Upper Tooting, S.W.
Francis Dickinson, 26, O'Connell Avenue, Berkeley Road, Dublin.
Edward Evans, 33, Ranelagh Road, Westminster, S.W.
Thomas Wallace Fagan, B.A., Harper Adams Agricultural College, Newport, Salop.
John Kerr Forrest, Hawsleigh, Balaclava Road, St. Kilda, N.S.W.
Thomas Reginald Hodgson, The Sycamores, Poulton-le-Fylde, Lancs.
George William Thomas Horrod, 294, Brixton Hill, S.W.
John Kenneth Harold Inglis, M.A., B.Sc., University College, W.C.
Thomas Campbell James, B.A., B.Sc., 4, Belmont Terrace, Llanelly.
Walter Richmond James, 49, Wednesfield Road, Wolverhampton.
John Richard Johnson, Apothecaries' Hall, E.C.
Horace Francis Jones, 3, Kerry Crescent, Calne, Wilts.
William App Jones, A.B., A.M., Ph.D., 12E, 18th Street, New York.
Alfred Francis Joseph, A.R.C.S., 95, Marylands Road, Maida Vale, W.
James Stanley Lauder, c/o B. Harvey, Qu'Appelle, N.W.T., Assa., Canada.
Arthur Garfield Levy, B.Sc., A.I.C., c/o B. Blount, Esq., 76, York Street, S.W.
James Patrick Longstaff, B.Sc., 19, Fettes Row, Edinburgh.
Arthur Thomas McDougall, B.A., 3, Albion Road, College Park, S.E.
Harold Joseph Clarke Mathews, Massey's Brewery, Ltd., Burnley, Lancs.

Ernest Westby Millar, A.R.C.S., Windsor, Monkstown, Co. Dublin.
Marie Jean Louis Ernest Rouillard, B.Sc., Malvern, Natal.
Percy Edwin Spielmann, A.R.C.S., 21, Cadogan Gardens, S.W
Harry Stanley, B.Sc., The Park, Southend Village, Catford, S.E.
Thomas Sutcliffe, 19, Rhodes Street, Halifax, Yorks.
Paul John Thibault, Howell, N.S.W.
Douglas Frank Twiss, M.Sc., 89, Wood Lane, Harborne, Birmingham.
Herbert Wood Watson, B.Sc., 111, Brudenell Road, Hyde Park, Leeds.
William Henry Willcox, M.D., B.Sc., F.I.C., St. Mary's Hospital, W.
Frank John Wyeth, M.A., 14, Preston Drove, Brighton.

The PRESIDENT, in announcing the lamented death of Professor Lobry de Bruyn, which occurred in July, after a short illness, reminded the Society that the deceased was one of the Honorary Foreign Members elected recently. A letter of sympathy and condolence had been immediately sent in the name of the Society to the widow, and it was hoped that an obituary notice would shortly appear in the Journal.

Of the following papers, those marked * were read:

*167. "**Studies on the dynamic isomerism of α- and β-crotonic acids. Part I.**" **By Robert Selby Morrell and Edward Kenneth Hanson.**

To show the change in the melting point with variation in the composition of a mixture of α- and β-crotonic acids at temperatures below the melting point of the less fusible component (α-crotonic acid), weighed quantities of the α-acid were added to a known weight of the β-acid, and the freezing point of the mixture observed. It was found that the freezing point of the β-crotonic acid fell from 14·96° to a minimum of −1·1°, and then rose to 43·9° on gradual addition of the α-acid until the mixture contained 30·8 per cent. of the β-acid. To complete the melting point curve, the lowering of the freezing point of α-crotonic acid by the β-isomeride was observed, and it was found that the curve was a continuous one from 15° through −3° (eutectic point) to 71·9°. There is no compound of α- and β-crotonic acids between these temperatures.

The investigation on the composition of the two acids at temperatures between 100° and 168° showed that β-crotonic acid changed on heating into the α-modification, and the composition of the mixture was found by cooling the fused mass rapidly and determining its freezing point. From the observed values of the freezing points for known mixtures of the two acids, the composition of the mixture was fixed

without having recourse to estimation by chemical methods. At 168°, the curve showing the transformation of the β-acid into the α-acid met the similar curve for the α-acid changing into the β-acid ; the composition at this point was 76 and 24 per cent. of the α- and β acids respectively. The boiling point under the ordinary pressure of a mixture of α- and β-crotonic acids is 168—174° (compare Michael, *J. pr. Chem.*, 1892, [ii], **46**, 146).

These preliminary experiments furnish no evidence as to the existence of a compound of α- and β-crotonic acids between 100° and 168°.

***168. "The constitution of nitrogen iodide." By Oswald Silberrad.**

The empirical formula of nitrogen iodide has been established by Chattaway (*Amer. Chem. J.*, 1900, **23**, 363, 369, and 1901, **24**, 138, 159, 318, 330, 342) as $N_2H_3I_3$, but the analytical results obtained by earlier workers showed great variations, chiefly due to unsuitable methods of preparation, insufficient precautions against the decomposing action of light, and faulty methods of analysis. In view of the methods of preparation and properties of the compound, the formula $N_2H_3I_3$ admits of two possible constitutions: $NH_3{:}NI_3$ and $NHI_2{:}NH_2I$. Chattaway's work does not differentiate between these two formulæ, and the earlier investigations offer no further proof as to the constitution. On the one hand, the liberation of ammonia by the action of acids supports the former configuration, whilst the formation of di-iodomethylamine by the action of methyl iodide appears to render the latter formula probable.

No direct derivatives of nitrogen iodide have so far been prepared in a pure state, the metallic compounds investigated have been incorrectly formulated owing to impurities in the products, and the only organic derivatives of nitrogen iodide hitherto obtained are those prepared by Stahlschmidt (*Poggendorff's Ann.*, 1863, **119**, 421) by the action of methyl iodide. These substances are so indirectly related to nitrogen iodide that they afford no definite proof as to its constitution.

In order to obtain substitution products closely related to nitrogen iodide, the action of zinc ethyl has been studied, and in this way it has been found possible to obtain direct proofs as to the constitution of the iodide.

Zinc ethyl reacts slowly with nitrogen iodide, producing volatile paraffins together with a white, amorphous compound, insoluble in ether, from which ammonia and triethylamine are obtained on treatment with dilute acid and subsequent distillation with aqueous

caustic potash. From this it is evident that the constitution of nitrogen iodide is represented by the formula $NH_3{:}NI_3$, and that the action of zinc ethyl proceeds according to the equation :

I. $NH_3{:}NI_3 + 3Zn(C_2H_5)_2 = 3Zn(C_2H_5)I + NH_3 + N(C_2H_5)_3$.

II. $2NH_3 + Zn(C_2H_5)_2 = Zn(NH_2)_2 + 2C_2H_6$.

This formula for the iodide is also supported by many of the observations of earlier investigators.

Discussion.

Dr. Chattaway recalled the fact that in conjunction with Dr. Orton (*Amer. Chem. Journal*, 1901, **24**, 342) he had shown that the formula $H_3N{:}NI_3$ alone could explain the actions which take place when nitrogen iodide is slowly decomposed by a stream of water. In such a progressive decomposition, this molecule is broken up and the ammonia washed away, while NI_3 mixed with iodine remains in the solid residue. If the ratio N : 3I could have been obtained, the formula would have been established beyond question, but, owing to the accumulation of iodine, a possibility of experimental error was introduced, and the ratio 1·18N : 3I was the nearest approach to this on which they felt able to rely confidently ; this ratio, however, excludes all formulæ except the one they put forward. Although he regarded this formula as undoubtedly correct, nevertheless Dr. Silberrad's evidence was not quite conclusive. He drew attention to the small yield of triethylamine, and suggested that under the experimental conditions much of the base would be found in combination with ethyl iodide as tetraethylammonium iodide. It seemed unlikely that nitrogen iodide could be properly dried in quantity by washing with alcohol and afterwards with ether, especially as the compound so very readily interacted with alcohol with the production of ethyl iodide, aldehyde, and ammonia. The triethylamine obtained under these conditions might have been formed by the interaction of ethyl iodide and the liberated ammonia.

He hoped to be able shortly to publish the results obtained by the study of the interaction of nitrogen iodide and the magnesium alkyl compounds, particularly the benzyl derivatives.

Mr. Smart, in replying on behalf of Dr. Silberrad, who was absent, stated that, although ammonia was produced in quantitative yield by the interaction of nitrogen iodide and zinc ethyl, yet the proportion of triethylamine obtained in these experiments was so small that it could not be detected until the experimental conditions had been carefully worked out, and even then large quantities of the iodide had to be treated in order that the base might be isolated and identified. The personal risk involved in treating a kilogram of nitrogen iodide under ether with zinc ethyl was very small in comparison with the

danger incurred in dropping the dry iodide into an ethereal solution of zinc ethyl. He believed that a pure metallic derivative of the nitrogen iodide had actually been obtained, and that a paper on this subject would shortly be communicated to the Society.

***169. "The available plant food in soils." By Herbert Ingle.**

The results of the author's investigation of the available plant food in soils lead to the following conclusions:

(1) That extraction with a 1 per cent. solution of citric acid for 7 days renders a soil much less fertile, especially at first, but that chemical changes in such soil, during the growth of the plants, gradually render it again capable of supplying plant food.

(2) That beans are able to extract a larger portion of the potash and phosphoric acid present in the soil than barley. This was especially so in the case where extracted soil was used.

(3) That Dyer's method (*Trans.*, 1894, 65, 115) of determining "available" plant food in soils is of considerable value in estimating their relative fertility, but that another factor must be considered, namely, the rate at which the "available" plant food is renewed, especially if the soils exist under different climatic conditions.

Whilst this is probably the same or nearly so for soils under similar climatic conditions, it may be, and probably is, very different in tropical or sub-tropical soils to what it is in those of temperate climates.

Discussion.

Dr. Dyer said that he had seen photographs of Mr. Ingle's pot culture experiments, and these certainly seemed to confirm the view that the phosphoric acid and potash soluble in 1 per cent. citric acid solution corresponded with the quantity of those constituents immediately available as plant food. But the most interesting part of Mr. Ingle's work on the subject was that showing the recuperative power of soils even after they had been artificially denuded of immediately available mineral food.

170. "The basic properties of oxygen: compounds of the ethers with nitric acid." By Julius Berend Cohen and John Gatecliff.

In view of recently published results on the additive compounds of the ethers, the following observations which were made early in the year may be of interest. In extracting with ordinary ether the products of the nitric acid oxidation of substituted toluenes, it was

frequently observed that, after dehydrating and removing the ether on the water-bath, a small quantity of yellow liquid remained which had a characteristic odour quite unlike that of ether. If this liquid were more strongly heated, or even left for a time, it decomposed with a succession of little explosions and the evolution of nitrous fumes. The liquid is produced by the action of nitric acid on ether and behaves qualitatively like a mixture of these two sub-tances. When added to strong sulphuric acid, nitric oxide is evolved, this result being also obtained by adding strong nitric acid to a mixture of strong sulphuric acid and ether. The liquid behaves like nitric acid to phenol, benzene, and aniline. In order to ascertain whether it had a definite composition the following experiments were made. Definite volumes of the purified ether and dilute nitric acid ($1HNO_3 : 2H_2O$) were shaken up in a separating funnel, the lower layer was removed, and the ethereal layer dehydrated for 24 hours over anhydrous sodium sulphate. The excess of ether was then removed by distillation until the thermometer registered 50°, when the process was stopped, for if the temperature rises above this point decomposition occurs and brown fumes are evolved. Air was now blown into the pale yellow residue contained in a beaker until the odour of ether had almost disappeared. As in this state the liquid decomposes rapidly at the ordinary temperature and slowly even at 0°, quantities of one to two grams were rapidly weighed and made up with water to 100 c.c. A measured volume was then titrated with standard caustic soda, using methyl-orange as indicator. The following results were obtained with purified methylated ether, ethyl ether, and propyl ether.

Ether employed.	Percentage of nitric acid in the product.	Volumes of ether and dilute nitric acid taken.
Methylated ether ...	45·2	50 c.c. HNO_3 : 50 c.c. ether
,, ...	44·4*	50 ,, ,, 50 ,,
,, ...	44·4	25 ,, ,, 50 ,,
Ethyl ether	47·3	50 ,, ,, 50 ,,
,, ...	47·5	50 ,, ,, 50 ,,
Propyl ether	33·8	50 ,, ,, 50 ,,
,, ...	35·9	50 ,, ,, 50 ,, .

* The ether in this case was not distilled, but evaporated at the ordinary temperature under 20 mm. pressure.

The calculated amounts of nitric acid corresponding with the formulæ $(C_2H_5)_2O,HNO_3$ and $(C_3H_7)_2O,HNO_3$ are 46 and 38·2 per cent. respectively. The agreement in the case of ethyl ether is quite satisfactory. The compound with propyl ether is evidently less stable at the ordinary temperature, the affinity for nitric acid appearing to diminish with increasing molecular weight. Amyl ether and dilute

nitric acid have no interaction at the ordinary temperature, and this is also the case with dimethylquinol, the only aromatic ether investigated.

171. "The condensation of formaldehyde with acetone. A preliminary note." By Emil Alphonse Werner.

When acetone is mixed with a 40 per cent. solution of formaldehyde, no interaction takes place until a small amount of alkali is added; if the liquids are mixed in the undiluted form, the addition of a small amount of caustic potash causes after a few moments a very violent reaction, the liquid boils, and an orange-red, resinous condensation product separates.

When the substances are mixed in 10 per cent. aqueous solution, the reaction proceeds much more slowly, the liquid gradually assumes a dark yellow colour, showing a green fluorescence; after one hour, the condensation product commences to separate as a bright orange-yellow powder, and at the end of 24 hours the reaction is complete. During the change, the alkalinity of the liquid diminishes considerably. The condensation product, when thoroughly washed and dried, forms an orange-yellow, amorphous, satiny powder with a peculiar odour. It has the empirical formula C_4H_5O: analysis gave C = 68·97 and 69·58, H = 7·46 and 7·54 per cent., whilst the calculated percentages are C = 69·56, H = 7·24. The compound is freely soluble in alcohol, acetone, or glacial acetic acid, and is precipitated unchanged by water; it dissolves sparingly in benzene, chloroform, or ether. The same substance is produced whether the acetone or the formaldehyde be used in excess.

It might have been expected that a compound having the composition C_4H_6O, that is, a polymeride of $CH{:}CH{\cdot}CO{\cdot}CH_3$ (C = 68·56, H = 8·56), would have been formed; this, however, does not appear to be the case. With bromine in glacial acetic acid solution, it behaves as a saturated compound, hydrogen bromide is evolved, and a mono-brominated derivative formed, which separates on diluting with water as a dark brown powder.

The addition of hydrochloric acid to the alkaline filtrate from the original experiment produces a yellow precipitate having the same composition as the orange-yellow condensation product.

172. "The union of hydrogen and chlorine. Rate of decay of the activity of gaseous chlorine." By Joseph William Mellor.

The rate at which active chlorine returns to the ordinary condition follows the exponential law $x = x_0 e^{-at}$, where x denotes activity at time

t, and a and x_0 are constants (a being 2·2 approximately). This is true when the activity is induced either by the electric discharge or by exposure to light.

173. "Note on the influence of certain salts and organic substances on the oxidation of guaiacum." By Miss Edith Gertrude Willcock.

The author has investigated the influence of various salts on the oxidation of guaiacum with hydrogen peroxide by determining the time necessary to produce a standard blue tint when the conditions were so adjusted that the concentration of guaiacum, peroxide, and salt, and the temperature were the same throughout the series.

It was found that the oxidation was accelerated by the chlorides of ammonium, lithium, potassium, barium, iron, and aluminium, the bromides of sodium and potassium, potassium iodide, sodium fluoride, and potassium nitrite; whereas the nitrates of ammonium, potassium, and barium, and the sulphates of sodium, potassium, and magnesium had no appreciable influence.

These results show (1) that the influence of the salt is determined by the nature of the anion, and (2) that the halogen salts as a group accelerate the oxidation.

Of the salts examined, those of the halogens alone showed a true accelerating action, for although potassium nitrite certainly accelerates the oxidation of guaiacum by hydrogen peroxide, yet as it will itself oxidise this resin in the absence of the peroxide its influence is not comparable with that of the salts which have no independent oxidising action; this remark also applies to ferric chloride.

A comparison of the salts of the halogens among themselves showed that the iodides have the greatest accelerating action, the effect of the others diminishing in the following order; namely, bromides, chlorides, and fluorides. The position of the iodides in the list may be connected with the oxidising action of hydrogen peroxide on these salts.

Salts such as aluminium chloride and sodium fluoride, which form acid solutions, have a relatively feeble accelerating power.

Ordinary "pure" aluminium chloride readily oxidises guaiacum even in the absence of peroxide, but a specially purified sample of the salt had no independent oxidising action whatever, and it increased the rate of oxidation by hydrogen peroxide only very slightly. The activity of commercial aluminium chloride is probably due to the presence of ferric chloride.

The acids of the acetic series have no accelerating action, but the metallic salts of the lower members of the series have a slight

influence, due probably to the fact that they are hydrolysed by water into free acid and base. Carbohydrates and proteids have no action.

Formaldehyde is commonly described as oxidising guaiacum, but this effect is probably due to impurities. The commercial product is an active oxidiser, turning guaiacum blue even in the absence of hydrogen peroxide, but pure formaldehyde, freshly prepared by the distillation of paraformaldehyde, has no action whatever.

Commercial glycerol readily oxidises guaiacum, turning the resin blue immediately, but in this case also the action seems to be due to impurities, for when freshly distilled under diminished pressure in the dark it has no effect by itself, although, like methyl and ethyl alcohols and ethylene glycol, it assists the accelerating action of the metallic haloids at the ordinary temperature (15—25°). These substances, however, at 50—70° all exert a retarding influence, and this may be due to some absorption of the available oxygen by the alcohol.

The carbohydrates dextrose, lævulose, sucrose, maltose, dextrin, starch, glycogen, and mastic decrease the accelerating action of the salts, and the proteid globulin has the same action.

The action of carbohydrates and proteids (globulins) in diminishing the accelerating power of salts is probably due to the fact that the organic substance, being itself oxidisable, absorbs a part of the oxygen which is liberated, and also to its influence on the degree of dissociation of the salt (compare Walker and Hambly, *Trans.*, 1897, **71**, 61).

The effect of sucrose on the electrical conductivity of sodium chloride has been measured by Mr. Hardy, who found that the presence of 16 per cent. of this sugar in a normal solution of the salt diminished the electrical conductivity by 23 per cent. (compare *J. Physiol.*, 1903, **29**, 26).

The accelerating action of the alcohols is adequately explained by their influence on the solubility of the guaiacum. When an alcoholic solution of the resin is added to water, precipitation occurs, but on the addition of more of the alcohol the precipitate redissolves. This was found to be the case with all the alcohols examined except mannitol, and this substance alone failed to accelerate the oxidation of the guaiacum.

174. "Note on the influence of potassium persulphate on the estimation of hydrogen peroxide." By John Albert Newton Friend.

It was shown in a recent communication (*Trans.*, 1904, **85**, 597 that in ordinary circumstances a correct estimate of hydrogen per-

oxide is not obtained by titration with potassium permanganate. The author now shows that for every molecule of peroxide not accounted for a molecule of persulphate disappears. This observation suggests that the reaction $H_2O_2 + K_2S_2O_8 = K_2SO_4 + H_2SO_4 + O_2$ probably takes place, this change being catalytically accelerated by some oxide of manganese formed during titration.

175. "The influence of sunlight on the dissolution of gold in aqueous potassium cyanide." By William Arthur Caldecott.

The fact that the formation of potassium thiocyanate in aqueous solution, under the conditions indicated by the equation $PbS + KCy + O = PbO + KCNS$, is accelerated by bright sunlight was noted some years ago by Bettel and Feldtmann (*Proc. Chem. Metallurg. Soc. S. Africa*, 1896, **1**, 267). In a paper published last year (*J. Chem. Metallurg. Soc. S. Africa*, 1903, **4**, 51) by E. H. Johnson and the author, the analogy between potassium aurocyanide and potassium thiocyanate with regard to their formation and reduction was discussed.

The following experiments were carried out with the view of ascertaining whether sunlight accelerated the formation of potassium aurocyanide, as well as that of potassium thiocyanate.

A strip of gold foil weighing 832·5 milligrams and having a total superficial area of 852 sq. mm. was immersed in a 0·5 per cent. potassium cyanide solution, contained in a clear glass litre bottle at about 19°. In another similar glass vessel, coated with three layers of black varnish, was placed a corresponding amount of the potassium cyanide solution and a strip of gold foil weighing 900 milligrams, but with a superficial area equal to that of the other strip. The two bottles were then exposed to direct sunlight for about 5½ hours daily during five days, the loss of weight of the gold foil strips was noted, the maximum temperatures of the solutions being recorded daily. The results were as follows:

	The clear bottle.		The blackened bottle.	
	Gold dissolved in milligrams.	Temp.	Gold dissolved in milligrams.	Temp.
1st day	25·5	36°	20·0	40°
2nd day	21·0	34	17·0	38
3rd day	28·0	34	20·0	38
4th day	27·0	37	17·0	40
5th day	32·0	39	19·0	43
Daily average	26·7	36	18·6	39·8

This table shows that the rate of dissolution of the gold in the clear glass bottle was 43 per cent. greater than that in the blackened vessel, although the temperature of the solution was on an average 3·8° lower than in the former case.

The lately published researches of Berthelot (*Compt. rend.*, 1904, 139, 169) indicate that the absorption of oxygen by aqueous potassium cyanide is accelerated by sunlight. The greater rapidity with which gold dissolves in potassium cyanide solution in bright sunlight may hence be considered as being due to the liberation of more nascent cyanogen, in proportion to the additional oxygen absorbed, with the consequent increased formation of aurous cyanide.

176. "The fractional hydrolysis of amygdalinic acid. *iso*Amygdalin." By Henry Drysdale Dakin.

As amygdalinic acid, prepared by the action of hot baryta solution on amygdalin, gives racemic mandelic acid on complete hydrolysis with acids, it is therefore probably a partially racemic substance, and may be considered as being the maltoside of inactive mandelic acid. On fractional hydrolysis, it was found that the mandelic acid set free in the earlier stages of the reaction was strongly dextrorotatory, whilst that liberated at a later stage was lævorotatory. By repeated crystallisation of the magnesium salts and of the free acids derived from the products of hydrolysis, it was found possible to isolate both optically active varieties of mandelic acid in a pure state.

Starting from amygdalin, which on hydrolysis gives *l*-mandelic acid almost exclusively, it is thus possible to prepare both *d*- and *l*-mandelic acids without employing any additional optically active substance.

The production of an isomeric partially racemic amygdalin, as the result of the limited action of baryta solution on amygdalin, was suggested by J. W. Walker (*Trans.*, 1903, 83, 472), but efforts to isolate the substance were unsuccessful.

The substance has now been obtained in crystalline form, and its main properties have been investigated; it is very much more soluble in water and alcohol, has a much lower melting point and a higher specific rotation than ordinary amygdalin. The close relationship between the two substances is shown by the fact that both are similarly attacked by the enzymes, emulsin and maltase.

The new substance gives amygdalinic acid and ammonia on treatment with alkali, whilst with concentrated acids it yields mandelic acid, glucose, and ammonia. The mandelic acid set free on complete hydrolysis with hydrochloric acid is distinctly dextrorotatory, whereas that derived from ordinary amygdalin is lævorotatory. The suggested cause of this surprising result is that the two forms of which *iso*-

amygdalin, as a partially racemic substance, may be assumed to be composed are hydrolysed at unequal rates, and that the form which is least readily hydrolysed undergoes progressive racemisation.

177. **"The effect of anhydrides on organo-magnesium bromides. Part I. The action of phthalic anhydride on magnesium α-naphthyl bromide."** By Samuel Shrowder Pickles and Charles Weizmann.

Although Grignard's reaction has been extensively used for the production of hydrocarbons, alcohols, and acids from ketones and esters, the effect of this reaction on anhydrides does not seem to have been studied. With the object of discovering another method for the preparation of certain quinones and their derivatives, the magnesium reaction was tried with magnesium α-naphthyl bromide and phthalic anhydride. The course of the reaction may be expressed as follows:

(1) Formation of additive compound:

$$C_6H_4\langle\begin{matrix}CO\\CO\end{matrix}\rangle O + C_{10}H_7\cdot MgBr = C_6H_4\langle\begin{matrix}C(C_{10}H_7)\cdot OMgBr\\CO\end{matrix}\rangle O.$$

(2) Action of water and dilute acid:

$$C_6H_4\langle\begin{matrix}C(C_{10}H_7)\cdot OMgBr\\CO\end{matrix}\rangle O + H_2O =$$

$$C_6H_4\langle\begin{matrix}C(C_{10}H_7)(OH)\\CO\end{matrix}\rangle O + MgO + HBr.$$

(3) Further action of water:

$$C_6H_4\langle\begin{matrix}C(C_{10}H_7)(OH)\\CO\end{matrix}\rangle O \longrightarrow C_6H_4\langle\begin{matrix}C(C_{10}H_7)(OH)_2\\CO_2H\end{matrix} \longrightarrow$$

$$C_6H_4\langle\begin{matrix}CO\cdot C_{10}H_7\\CO_2H\end{matrix} + H_2O,$$

the product of the reaction being a keto-acid, in this case, α-naphthoyl-*o*-benzoic acid.

Such acids, on treatment with strong sulphuric acid, pass almost at once into quinones, the foregoing acid, for example, yielding naphthanthraquinone.

Subsequent experiments have shown that the above reaction is capable of general application. Thus, using phthalic anhydride and bromobenzene, the authors have obtained benzoyl-*o*-benzoic acid and anthraquinone, and with phthalic anhydride and β-bromonaphthalene they have obtained β-naphthoyl-*o*-benzoic acid and naphthacenequinone.

Experiments are now being carried out in the aliphatic series with succinic anhydride and various fatty bromides.

178. "The combustion of ethylene." By William Arthur Bone and Richard Vernon Wheeler.

The combustion of ethylene appears to be essentially a process of hydroxylation, that is, oxygen initially enters the hydrocarbon and is distributed between the carbon and hydrogen, giving rise to hydroxylated molecules, which sooner or later, according to the rapidity of the process, undergo thermal decompositions into simpler products. The stages in the combustion are represented by the following scheme:

$$\begin{matrix}CH_2\\ \|\\ CH_2\end{matrix} \longrightarrow \begin{matrix}CH\cdot OH\\ \|\\ CH_2\end{matrix} \longrightarrow \begin{matrix}CH\cdot OH\\ \|\\ CH\cdot OH\end{matrix} = 2\left\{ \underbrace{O{:}\overset{H}{\overset{|}{C}}H}_{CO+H_2} \longrightarrow \underbrace{O{:}\overset{H}{\overset{|}{C}}\cdot OH}_{CO+H_2O} \longrightarrow \underbrace{O{:}\overset{OH}{\overset{|}{C}}\cdot OH}_{CO_2+H_2O} \right\}$$

The more salient features of the experiments may be summarised as follows:

(1) There is no preferential combustion of either carbon or hydrogen when ethylene interacts with a quantity of oxygen insufficient to burn it completely to steam and oxides of carbon. The separation of carbon or hydrogen, when it does occur, is to be entirely ascribed to secondary thermal decompositions.

(2) Formaldehyde is the most prominent intermediate oxidation product, and at low temperatures its formation is probably preceded by that of a less oxygenated product.

(3) The formation of aldehydes precedes that of steam and oxides of carbon.

(4) The stage in the combustion process at which secondary decompositions set in is determined entirely by the temperature conditions. Below the ignition point, such changes do not come into play to any appreciable extent until the stage corresponding with the formation of formic acid is reached. The greater part of this substance then decomposes into carbon monoxide and steam, whilst the remainder is further oxidised to carbonic acid, which in turn breaks down into carbon dioxide and steam. Above the ignition point, the formaldehyde produced rapidly decomposes into carbon monoxide and hydrogen.

(5) There is no separation of carbon or liberation of acetylene, even in the explosive combustion of ethylene, except when the oxygen present is insufficient to burn the hydrocarbon to formaldehyde. In such circumstances, the excess of ethylene is thermally decomposed, yielding carbon, hydrogen, methane, and traces of acetylene. Some evidence was obtained under suitable conditions of the transformation of the initial product, $CH_2{:}CH\cdot OH$, into the isomeric acetaldehyde, which is then independently oxidised to carbon monoxide, water, and formaldehyde, as proved in a previous paper.

The authors have not yet decided whether at low temperatures the oxygen is conveyed to the hydrocarbon directly or indirectly, but at high temperatures, as, for example, in the explosion wave, it is believed that there is a direct passage from $\begin{matrix}H\cdot C\cdot H\\ \|\\ H\cdot C\cdot H\end{matrix}$ to $\begin{matrix}H\cdot C\cdot OH\\ \|\\ H\cdot C\cdot OH'\end{matrix}$ as the result of collisions between single molecules of ethylene and oxygen.

179. "The decomposition of methylcarbamide." By Charles Edward Fawsitt.

This investigation has been conducted on similar lines to that on carbamide (*Zeit. physikal. Chem.*, 1902, 41, 601), and it is found that the mechanism of the decomposition is precisely similar in the two cases, so that the theory put forward to explain the decomposition of carbamide is also applicable in the present instance.

The decomposition of methylcarbamide by acids is due to a transformation of the methylcarbamide into methylamine cyanate, which is subsequently decomposed by the acid. The initial transformation is a reaction of the first order, and the velocity coefficient at 99° is almost exactly one-half that of carbamide. In these experiments it is only the free methylcarbamide which represents the active concentration of substance decomposing at any instant. A direct hydrolysis is brought about only very slightly even by very concentrated alkali, and the reaction with pure water is very much slower than is the case with carbamide.

180. "Position isomerism and optical activity; the methyl and ethyl esters of di-*o*-, -*m*-, and -*p*-nitrobenzoyltartaric acids." By Percy Faraday Frankland and John Harger.

The authors describe the preparation and properties of the six esters in question, which were obtained by the action of the three isomeric nitrobenzoyl chlorides on methyl and ethyl tartrates respectively. The rotation of each was determined in the fused state, and over a wide range of temperature, in some cases from 15° to 180°. All these compounds, like the corresponding dibenzoyl- and ditoluyl-tartrates, are strongly lævorotatory. The *p*- and *m*-nitrobenzoyl groups were found to exercise a very great rotatory effect, the molecular rotations of the diethyl di-*p*- and di-*m*-nitrobenzoyltartrates and of the dimethyl di-*p*-nitrobenzoyltartrate being considerably in excess of those exhibited by the corresponding dibenzoyl- and ditoluyl-tartrates. The dimethyl di-*m*-nitrobenzoyltartrate, on the other hand, exhibited a molecular

rotation which, although considerably greater than that of dimethyl dibenzoyltartrate, was almost identical with that of dimethyl di-*m*-toluyltartrate.

The *o*-nitrobenzoyl group behaved in an altogether exceptional manner, its relative rotatory influence being entirely dependent on the temperature. Thus it has been previously shown by one of the authors (P. Frankland and Wharton, *Trans.*, 1896, 69, 1591) that the rotatory effect of the *o*-toluyl group is inferior to that of the benzoyl group, and it would have been anticipated, therefore, that the *o*-nitrobenzoyl radicle should exert a still smaller effect; this was actually found to be the case above 130°, but with fall of temperature its rotatory effect so rapidly increases that at 15° the latter proved to be even greater than that of the *p*-nitrobenzoyl group. This abnormal behaviour of the *o*-nitrobenzoyl group, which was only fully studied in the case of the ethyl compound, was thus limited to the superfused state, the melting point of diethyl di-*o*-nitrobenzoyltartrate being 143°. This melting point, again, is exceptional in being considerably higher than that of the meta- (95·8°) and that of the para- (124·5°) compounds respectively.

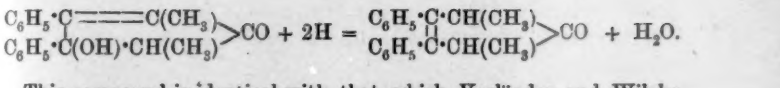
The rotation of all these compounds is very sensitive to temperature, diminishing in every case as the latter rises, much the largest temperature-coefficient being possessed by the ortho-compound.

181. "The action of nitrogen sulphide on organic substances. Part II." By Francis Ernest Francis and Oliver Charles Minty Davis.

The action of nitrogen sulphide on anisaldehyde gives rise to tri-*p*-methoxycyanidine and anisamidine sulphate, which are isolated by taking advantage of their solubilities in benzene and water respectively. An insoluble derivative of anisamidine, containing sulphur, is also produced which is very stable towards alkalis but yields anisoylanisamidine on treatment with strong acids.

182. "Reduction products of $\alpha\beta$-dimethylanhydracetonebenzil, and condensation products of benzaldehydes with ketones." By Francis Robert Japp and William Maitland.

When $\alpha\beta$-dimethylanhydracetonebenzil is boiled for a few minutes with fuming hydriodic acid, it is reduced to a *cyclopentenone* derivative (m. p. 122°):

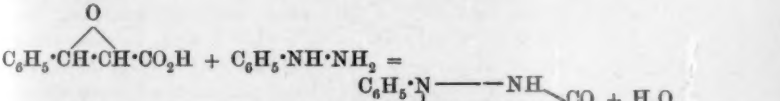


This compound is identical with that which Vorländer and Wilcke (*Ber.*, 1898, **31**, 1887) obtained by the action of hydrogen chloride on dimethyldiphenyltetrahydro-γ-pyrone, but which they erroneously regard as dibenzylidenediethylketone. By further reduction with hydriodic acid, it yields the corresponding *cyclopentanone* derivative.

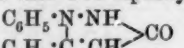
The authors have prepared various alkyl derivatives of tetrahydro-γ-pyrone by the usual method of condensing benzaldehyde with aliphatic ketones, and have studied their reactions, especially with the view of obtaining *cyclo*pentenone derivatives.

183. "Interaction of sodium phenylglycidate with phenylhydrazine." **By Francis Robert Japp and William Maitland.**

When sodium phenylglycidate is heated with phenylhydrazine in alcoholic solution at 100°, *4-hydroxy-1 : 5-diphenyl-3-pyrazolidone* (m. p. 173·5°) is obtained in the form of its sodium salt:



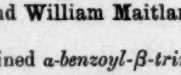
By the action of heat or of dehydrating agents, hydroxydiphenylpyrazolidone is converted into 1 : 5-diphenyl-3-pyrazolone,



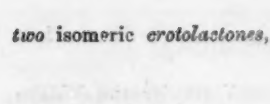
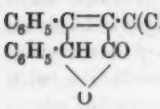
(m. p. 252°), previously obtained by Knorr (*Ber.*, 1887, **20**, 1107) by distilling cinnamoylphenylhydrazine.

184. "α-Benzoyl-β-trimethacetylstyrene." **By Francis Robert Japp and William Maitland.**

The authors have obtained *α-benzoyl-β-trimethacetylstyrene*,

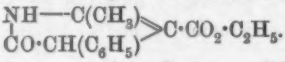


(m. p. 115°), by the action of potassium hydroxide on a mixture of benzil and methyl *tert.*-butyl ketone. In its reactions, it closely resembles *αβ*-dibenzoylstyrene (Japp and Klingemann, *Trans.*, 1890, **57**, 662), except that, on heating, it is converted into a mixture of

two isomeric *crotolactones*,  (m. p. 150°) and  (m. p. 75°).

185. "Olefinic ketonic compounds." By Siegfried Ruhemann.

Rabe (*Ber.*, 1902, **35**, 3947) stated that the additive compound of aniline and ethyl benzylideneacetoacetate melted at 78° instead of at 105° (erroneously printed as 103°) as found by Ruhemann and Watson (*Trans.*, 1904, **85**, 1170). On re-examination, it was found that the melting point could be raised to 106—107°, which closely agreed with that given by Francis (*Ber.*, 1903, **36**, 937) for the substance he obtained by combining benzylideneaniline with ethyl acetoacetate.

The author also examined the action of potassium cyanide on benzylideneacetylacetone and ethyl benzylideneacetoacetate respectively, and found that in the first case cyanobenzylacetylacetone, $C_6H_5\cdot CH(CN)\cdot CH(CO\cdot CH_3)_2$ (m. p. 127—128°), and, in the other, ethyl cyanobenzylacetoacetate, $C_6H_5\cdot CH(CN)\cdot CH(CO\cdot CH_3)\cdot CO_2\cdot C_2H_5$, are produced. On hydrolysis with caustic potash, the former nitrile furnishes phenylacetopropionic acid, $C_6H_5\cdot CH(CO_2H)\cdot CH_2\cdot CO\cdot CH_3$, whilst ethyl cyanobenzylacetoacetate yields a mixture of phenylacetopropionic and phenylsuccinic acids. Under the influence of concentrated sulphuric acid, cyanobenzylacetylacetone is transformed into phenyldiacetopropionic acid, $C_6H_5\cdot CH(CO_2H)CH(CO\cdot CH_3)_2$ (m. p. 149—150°); ethyl cyanobenzylacetoacetate, on the other hand, furnishes the dihydropyrone derivative,  .

The mode of formation and the properties of cinnamylideneacetylacetone, $C_6H_5\cdot CH{:}CH\cdot CH{:}C(CO\cdot CH_3)_2$ (m. p. 103—104°), are also described. This di-olefinic ketone, on exposure to light, undergoes a change similar to that occurring in the case of cinnamylidenemalonic acid (Liebermann, *Ber.*, 1895, **28**, 1440; Riiber, *Ber.*, 1902, **35**, 2411), and yields a colourless substance (m. p. 158—159°) which has double the molecular weight of cinnamylideneacetylacetone. These two compounds are still under examination.

186. "Δ^{α}-Oleic acid." By Henry Rondel Le Sueur.

In a former communication (*Trans.*, 1904, **85**, 827), the author stated that he was engaged in the preparation of an isomeride of oleic acid containing the double linking between the α- and β-carbon atoms, and, although the work is not complete, the appearance of a paper by G. Ponzio (*Gazzetta*, 1904, **34**, ii, 77; *Chem. Centr.*, 1904, ii, 691) on the same subject necessitates the publication of the results so far obtained.

Δ^{α}-*Oleic acid*, $C_{15}H_{31}\cdot CH{:}CH\cdot CO_2H$, obtained by the action of alcoholic potash on α bromostearic acid, crystallises from light petroleum in long, flat needles melting at 58—59°; its *ethyl ester* melts at 25—26°. The acid, on oxidation with potassium permanganate, yields $\alpha\beta$-*dihydroxystearic acid* melting at 126°, which on further oxidation yields palmitic acid, thereby proving the position of the double linking.

187. "Action of magnesium alkyl halides on derivatives of camphor." By Martin Onslow Forster.

The action of magnesium alkyl halides on derivatives of camphor is not always normal, and several interesting changes have been observed.

The *compound*, $C_{12}H_{22}O_2$, from camphorquinone and magnesium methiodide is a volatile, colourless compound, dissolving readily in organic media and very sparingly in water, from which it crystallises in minute, transparent prisms and needles melting at 132°. A 2 per cent. solution in absolute alcohol is optically inactive.

The *compound*, $C_{11}H_{19}O_2N$, from *iso*nitrosocamphor and magnesium methiodide is soluble in acids and alkalis, forming colourless solutions; it separates from boiling water as a crystalline powder and melts at 180°.

The *compound*, $C_{11}H_{19}O_3N$, from nitrocamphor and magnesium methiodide is insoluble in sodium carbonate solution, but dissolves in aqueous sodium hydroxide; it crystallises from petroleum in lustrous leaflets melting at 83°.

The *compound* from hydroxymethylenecamphor and magnesium methiodide is a colourless, fragrant oil which boils at 234°/765 mm., has sp. gr. 0·9639, and $[\alpha]_D$ 170·8°. It is insoluble in aqueous sodium hydroxide, and gives no coloration with ethereal ferric chloride.

188. "Sulphonchloroalkylamides." By Frederick Daniel Chattaway.

In the course of an investigation of nitrogen halogen derivatives of the sulphonamides, a number of compounds yielded by various methyl, ethyl, and benzyl derivatives of the sulphonamides have been obtained. All the sulphonalkylamides are readily converted by a solution of hypochlorous acid into the corresponding chloroamides, $RSO_2 \cdot NHR' + HOCl = RSO_2 \cdot NClR' + H_2O$. Those containing methyl and ethyl groups are comparatively stable, whereas those in which benzyl occurs undergo spontaneous decomposition after a few hours; even when kept in dry air, chlorine and hydrogen chloride are liberated, while a pungent odour, resembling that of benzaldehyde, becomes apparent. When rapidly heated, they all decompose with evolution of gas, but without explosion. Like the sulphondichloroamides, they are very reactive, and promise to be of considerable value in the synthesis of secondary amines containing different alkyl groups.

The following compounds are typical examples of a long series of these substances which has been prepared. Benzenesulphonchloromethylamide, $C_6H_5 \cdot SO_2 \cdot NCl \cdot CH_3$, colourless, short rhombs, m. p. 81°; benzenesulphonchloroethylamide, $C_6H_5 \cdot SO_2 \cdot NCl \cdot C_2H_5$, colourless plates, m. p. 52°; benzenesulphonchlorobenzylamide, $C_6H_5 \cdot SO_2 \cdot NCl \cdot CH_2 \cdot C_6H_5$, colourless, slender prisms, m. p. 109°; *p*-toluenesulphonchloromethylamide, $CH_3 \cdot C_6H_4 \cdot SO_2 \cdot NCl \cdot CH_3$, colourless prisms, m. p. 82°; *m*-nitrobenzenesulphonchloromethylamide, $NO_2 \cdot C_6H_4 \cdot SO_2 \cdot NCl \cdot CH_3$, pale yellow, four-sided plates, m. p. 136°; α-naphthalenesulphonchloromethylamide, $C_{10}H_7 \cdot SO_2 \cdot NCl \cdot CH_3$, colourless, six-sided prisms, m. p. 78°; α-naphthalenesulphonchlorobenzylamide, $C_{10}H_7 \cdot SO_2 \cdot NCl \cdot CH_2 \cdot C_6H_5$, very pale yellow prisms, m. p. 94°; β-naphthalenesulphonchloromethylamide, colourless prisms, m. p. 91°; β-naphthalenesulphonchloropropylamide, $C_{10}H_7 \cdot SO_2 \cdot NCl \cdot C_3H_7$, colourless plates, m. p. 86°.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 5th, 1904.

At the next ordinary meeting, on **Wednesday**, November 16th, 1904, at **5.30** p.m., the following papers will be communicated :

"The isomerism of the amidines of the naphthalene series." By R. Meldola and J. H. Lane.

"Theory of the production of mercurous nitrite and of its conversion into various mercury nitrates." By P. C. Rây.

"Amidechloroiodides." By G. D. Lander.

"A new synthesis of *iso*caprolactone and some derivatives." By D. T. Jones and G. Tattersall.

"The influence of substitution in the nucleus on the rate of oxidation of the side-chain. Part II. Oxidation of the halogen derivatives of toluene." By J. B. Cohen and J. Miller.

"The halogen derivatives of naphthacenequinone." By S. S. Pickles and C. Weizmann.

"Constitution of pyrazolidone derivatives." By B. Prentice.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Arnold, Carl. Compendium of chemistry, including general, inorganic, and organic chemistry. Translated by John A. Mandel. pp. 627. New York 1904. From the Publishers.

Beadle, Clayton. Chapters on papermaking. Vol. I. pp. 151. London 1903. From the Author.

Behring, E. von. The suppression of tuberculosis, together with observations concerning phthisiogenesis in man and animals, and suggestions concerning the hygiene of cow stables and the production of milk for infant feeding, with special reference to tuberculosis. Translated by Charles Bolduan. pp. vi + 85. New York 1904. From the Publishers.

Benedicks, Carl. Recherches physiques et physico-chimiques sur l'acier au carbone. pp. 219. ill. Uppsala 1904. From the Author.

Getman, Frederick H. Laboratory exercises in physical chemistry. pp. viii + 241. New York 1904. From the Publishers.

Girard, Charles. Analyse des matières alimentaires, et recherche de leurs falsifications. pp. 871. ill. Paris 1904. From the Publisher

Graebe, Carl. Graebe-Feier, Cassel, 20th September, 1903. pp. 138. ill. Genf 1903. From Dr. R. H. Aders Plimmer.

Holleman, A. F. A laboratory manual of organic chemistry for beginners. An appendix to the author's text-book of organic chemistry. Translated by A. Jamieson Walker. pp. 78. New York 1904. From the Publishers.

Jones, Chapman. The science and practice of photography. Fourth edition. pp. 569. ill. London 1904. From the Author.

Merget, H. Index to the literature of thorium, 1817—1902. Smithsonian Miscellaneous Collections. Vol. xliv. Washington 1904. From the Smithsonian Institution.

Kyōto Imperial University. Memoirs of the College of Science and Engineering. Vol. I, No. 1. 1903. From the University.

Langworthy, C. F., and Austen, Peter T. The occurrence of aluminium in vegetable products, animal products, and natural waters. A contribution to the bibliography of the subject. pp. 168. New York 1904. From the Publishers.

Leach, Albert E. Food inspection and analysis. For the use of public analysts, health officers, sanitary chemists, and food economists. pp. xiv + 787. ill. New York 1904. From the Publishers.

Lippmann, Edmund O. von. Die Chemie der Zuckerarten. 3rd edition of *Die Zuckerarten und ihre Derivate.* 2 vols. pp. 2003. Braunschweig 1904. From the Publishers.

Liversidge, A. Tables for qualitative chemical analysis. pp. 126. London 1904. From the Author.

Manchester, Rivers Department. Annual Report, year ending March 30th, 1904. pp. 44. From the Corporation.

Morse, Irving H. Calculations used in cane-sugar factories. A practical system of chemical control for Louisiana sugar-houses and other cane-producing countries. pp. viii + 75. New York 1904. From the Publishers.

Riggs, Louis Warner. Elementary manual for the chemical laboratory. pp. 138. New York 1904. From the Publishers.

Royal Society of London. Record. Second edition, 1901. pp. 427. From the Society.

Schmidt, G. C. Die Kathodenstrahlen. pp. 120. ill. Braunschweig 1904. From the Publishers.

Stoddart, F. Wallis. On the best method of sewage disposal for small communities. pp. 32. ill. Bristol 1904. From the Author.

Sutton, Francis. Systematic handbook of volumetric analysis. Ninth edition. pp. xii + 617. ill. London 1904. From the Author.

Treadwell, F. P. Analytical chemistry. Volume II. Quantitative analysis. Translated by William T. Hall. pp. 654. ill. New York 1904. From the Publishers.

United States, Philippine Commission. Report of the Superintend-

ent of Government Laboratories in the Philippine Islands, for the year ended September 1st, 1903. pp. 278. ill. 1904.
From the Commission.

University of California. Report of work of the Agricultural Experiment Station of the University of California. 1901—1903. pp. 222. ill. From the University.

Wachter, Wilhelm. Das Feuer in der Natur, im Kultus und Mythus, im Völkerleben. pp. 166. Leipzig 1904.
From the Publisher.

Wallace, Robert. Argentine shows and live stock. pp. 154. ill. Edinburgh 1904. From the Author.

Wassermann, A. Immune sera: hæmolysins, cytotoxins, and precipitins. Authorised translation by Charles Bolduan. pp. 77. ill. New York 1904. From the Publishers.

West Indies, Imperial Department of Agriculture. Sugar-cane experiments in the Leeward Islands. Part I. Experiments with varieties of sugar-cane, with appendices on the chemical selection of sugar-cane. Part II. Manurial experiments. pp. 68, 115. Barbados 1904. From the Department.

II. *By Purchase.*

Bischof, Carl. Die feuerfesten Tone. Deren Vorkommen, Zusammensetzung, Untersuchung, Behandlung und Andwendung. Mit Berücksichtigung der feuerfesten Materialien überhaupt. Dritte Auflage von Hermann Kaul. pp. viii + 446. ill. Leipzig 1904.

Borchers, W. Die Beziehungen zwischen Äquivalentvolumen und Atomgewicht. Ein Beitrag zur Festigung und Vervollständigung des periodischen Systems der Elemente. pp. 17. Halle 1904.

Collin, Eugene, et Perrot, Em. Les résidus industriels de la fabrication des huiles et essences utilisés par l'agriculture comme aliments et comme engrais. pp. 299. ill. Paris 1904.

Eder, J. M., and Valenta, E. Beiträge zur Photochemie und Spectralanalyse. pp. 868. ill. Wien 1904.

Hammarsten, Olof. Lehrbuch der physiologischen Chemie. Fünfte Auflage. pp. 715. Wiesbaden 1904.

Hime, Henry W. L. Gunpowder and ammunition, their origin and progress. pp. 256. London 1904.

Jahrbuch der Radioaktivität und Elektronik. Herausgegeben von Johannes Stark. Band I. 1904.

Kekulé, August. Über die Konstitution und die Metamorphosen der chemischen Verbindungen und über die chemische Natur des Kohlenstoffs. Untersuchungen über aromatische Verbindungen.

Herausgegeben von A. Ladenburg. (Ostwald's *Klassiker*, No. 145.) Leipzig 1904.

Kepler, Johannes. Dioptrik oder Schilderung der Folgen, die sich aus der unlängst gemachten Erfindung der Fernrohre für das Sehen und die sichtbaren Gegenstände ergeben, 1611. Herausgegeben von Ferdinand Plehn. (Ostwald's *Klassiker*, No. 144.) Leipzig 1904.

König, J. Chemie der menschlichen Nahrungs- und Genussmittel. Band II. Die menschlichen Nahrungs- und Genussmittel, ihre Herstellung, Zusammensetzung und Beschaffenheit, nebst einem Abriss über die Ernährungslehre. Vierte Auflage. pp. xxv + 1557. ill. Berlin 1904.

Lassar-Cohn. Allgemeine Gesichtspunkte für organisch-chemisches Arbeiten. pp. 79. Hamburg 1904.

Möller, Joh. Die elektrochemische Reduktion der Nitroderivate organischer Verbindungen in experimenteller und theoretischer Beziehung. pp. 113 + vii. Halle 1904.

Ostwald, Wilhelm. Abhandlungen und Vorträge, 1887—1903. pp. x + 468. Leipzig 1904.

Sturm, C. Abhandlung über die Auflösung der numerischen Gleichungen, 1835. Herausgegeben von Alfred Loewy. (Ostwald's *Klassiker*, No. 143.) Leipzig 1904.

Walden, P. Wilhelm Ostwald. pp. 120. ill. Leipzig 1904.

Werner, A. Lehrbuch der Stereochemie. pp. xvi + 474. ill. Jena 1904.

III. *Pamphlets.*

Bigelow, W. D. Foods and food control. I. Legislation during the year ended July 1, 1903. (U.S. Dept. of Agric. Bureau of Chemistry Bulletin, No. 83, Part I.) 1904.

British Guiana. Report by Professor Harrison on the results of experiments with varieties of canes carried on on sugar plantations in the colony. pp. 8. Demerara 1904.

Cain, John Cannell. The constitution of the ammonium compounds. (From the *Mem. Manchester Phil. Soc.*, 48, 1904.)

Cape of Good Hope. Report of the Senior Analyst for the year 1903. pp. 72. 1904.

Davis, Charles B. Steely malt in modern brewing and the filter press. (From the *Transactions of the American Brewing Institute*, 2, 1904.)

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Issued 24/11/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 285.

Wednesday, November 16th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Professor P. C. Rây was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.

Francis William Frederick Arnaud, A.I.C., 17, Maddox Street, W.
George Douglas Clarkson, Ash House, Mirfield, Yorks.
Samuel George Eade, 10, Eagle Street, Port Talbot, S. Wales.
Carl Richard Hennings, Ph.D., 19, St. Dunstan's Hill, E.C.
Tudor Foulkes Jones, B.Sc., Bro Dawel, Bangor, North Wales.
William Sloan Mills, M.A., Queen's College, Galway.
Harold Schröder, Lithgow, New South Wales.
Ernest Wheeler, 335, Park Road, Oldham, Lancs.
John Henry Becher Wigginton, Kennington Cross, S.E.

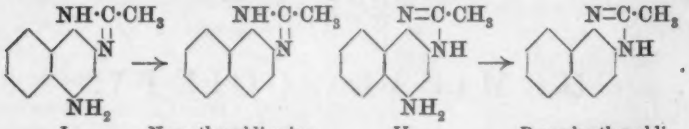
A certificate in favour of the following was authorised by the Council for presentation for ballot under Bye-law I.

Gustav Komppa, Ph.D., Polytechnik, Helsingfors.

Of the following papers, those marked * were read:

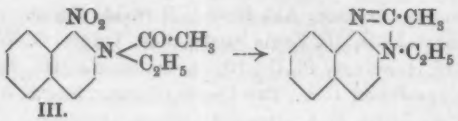
***189. "The isomerism of the amidines of the naphthalene series (fifth communication on anhydro-bases)." By Raphael Meldola and Joseph Henry Lane.**

When 2 : 4-dinitroaceto-α-naphthalide is reduced by tin and hydrochloric acid, the aminoamidine (M. and S. ethenyltriaminonaphthalene) has the α-NH constitution (No. I), and the isomeric base (Markfeldt's), produced when iron and hydrochloric acid are used for reduction, has the β-NH constitution (No. II). The constitution of the corresponding ethenyldiaminonaphthalenes follows from this result:

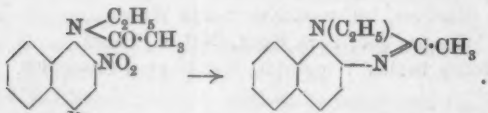


I. New ethenyldiaminonaphthalene (*Trans.*, 1903, **83**, 1190). II. Prager's ethenyldiaminonaphthalene.

This conclusion has been reached by a comparison of the *N*-alkylamidines obtained by the direct alkylation of the ethenyldiaminonaphthalenes with the *N*-alkylamidines prepared synthetically and of known constitution. Thus the *N*-ethylamidine, prepared by the direct ethylation of Prager's base, is identical with the base prepared by reducing the compound No. III, and the isomeric *N*-ethylamidine, obtained by the ethylation of the new ethenyldiaminonaphthalene (*Trans.*, 1903, **83**, 1193), is identical with the base prepared by reducing compound No. IV and then debrominating the product:



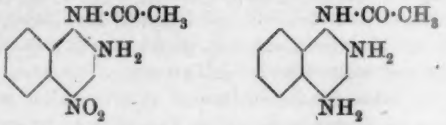
III.



IV.

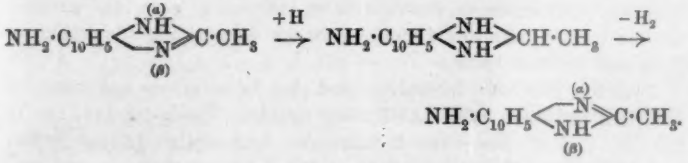
It has thus been shown that the isomerism of the ethenyltriaminonaphthalenes is a case of structural isomerism brought about by a novel and, up to the present time, unique method, namely, the action of different reducing agents on the same dinitro-compound. In

explanation of this isomerisation, the hypothesis is advanced that one of the reducing agents, probably the iron, effects a fractional reduction of the nitro-groups, while the other reducing agent attacks both nitro-groups simultaneously. The formation of the amidine ring would thus take place in one case under the orienting influence of the NO_2-group, and in the other case under the orienting influence of the NH_2-group, and the resulting anhydro-bases might under these conditions be expected to be isomeric, the intermediate phases being the compounds :



The investigation is being extended to the benzene series so as to obtain evidence, if possible, of the intermediate phases.

The transformation of the α-NH-aminoamidine into the β-NH-aminoamidine (Trans., 1903, **83**, 1200) is explained by the temporary saturation of the amidine ring by hydrogen and the subsequent removal of the element in accordance with the scheme :



Discussion.

Dr. Lander asked whether Professor Meldola had observed tautomeric relationships between the isomeric amidines. The work might be regarded as settling the nature of the so-called "virtual" tautomerism of the open-chain mixed amidines discovered by von Pechmann.

Dr. Kohn inquired whether the author had tried to reduce the dinitro-compound electrolytically. If not, this method might throw some light on the suggested hypothesis of the formation of the two amidines, since the stages observed in the electrolytic reduction of nitro-compounds were somewhat different from those which obtained with the use of metals and acid.

Dr. Divers asked whether the production of one or other aminoamidine, according to the metal employed, might not rather be due to the reducing action of stannous or ferrous chloride than to that of the metal itself. But even although due to the action of the metal,

there may be difference in the effect because the reduction is not caused actually by hydrogen, but by the combined simultaneous action of the metal and the 2 : 4-dinitroaceto-α-naphthalide on the hydrochloric acid.

Dr. MORGAN remarked that the hypothesis that iron and hydrochloric acid reduced the nitro-groups of 2 : 4-dinitroaceto-α-naphthalide successively was supported by the known behaviour of this reducing agent towards *m*-dinitro- compounds in the benzene series. The production of *m*-nitraniline from *m*-dinitrobenzene by the action of limited amounts of iron and acid had formerly been patented (D.R.-P. 67018). He had likewise found that, in the case of dinitromesitylene, the use of iron and water with a small amount of acetic or hydrochloric acid as catalyst led to the production of nitromesidine, whereas complete reduction to diaminomesitylene was effected by employing tin and hydrochloric acid.

Quite recently, Meister, Lucius, & Brüning (D.R.-P. 151768, *Abstr.*, 1904, i, 943) had obtained 1-acetylamino-2 : 4-diaminonaphthalene from 2 : 4-dinitroaceto-α-naphthalide by using iron and acetic acid. As the authors assumed that this acetyltriamine was an intermediate product in the formation of one of the two isomeric aminoamidines, it would be of interest to ascertain whether the acetylated base would yield by direct dehydration the isomeride predicted by their theory.

Professor MELDOLA, in reply, stated that both ferrous and stannous chlorides had been tried as reducing agents. The latter gave rise to the M. and S. base, the former was apparently without action under ordinary conditions. Several metals other than tin and iron had been used as reducing agents, and the results were described in the present and in former papers. Thus far, the action of iron in giving rise directly to Markfeldt's base appeared to be unique.

The practical difficulty that presented itself in all the experiments was the great insolubility of 2 : 4-dinitroaceto-α-naphthalide. This compound was practically insoluble in cold alcohol and acetic acid. With concentrated sulphuric acid as a solvent, there was a danger of the acetyl group being split off. For this reason, electrolytic reduction had not hitherto been attempted. He agreed with Dr. Lander's view that the results arrived at might be regarded as settling the question of the "virtual" tautomerism of the amidines raised by von Pechmann. There seemed to be no tautomeric relations between the isomeric amidines or aminoamidines. The patented process for preparing acetyltriaminonaphthalene referred to by Dr. Morgan had not yet been tried.

***190. "Theory of the production of mercurous nitrite and of its conversion into various mercury nitrates." By Prafulla Chandra Rây.**

Mercurous nitrite is the sole product, other than water, of the immediate action of mercury on dilute nitric acid containing any nitrous acid. In the absence of the latter acid, the former is quite inactive. The formation of the salt may be expressed by the equation $2Hg + NO_2H + HO{\cdot}NO_2 = Hg_2(NO_2)_2 + H_2O$, but it is in part converted by nitric acid into nitrate and nitrous acid. At suitable temperatures and in presence of the right proportions of water and nitric acid, a stage is soon reached in which the quantity of nitrite produced by nitrous acid is just balanced by that decomposed by nitric acid. There then ensues for some time a steady accumulation of mercurous nitrite, during which the production of permanent nitrite is due wholly to the nitric acid, as expressed by the equation $4Hg + 4HNO_3 = Hg_2(NO_2)_2 + Hg_2(NO_3)_2 + 2H_2O$. So long as this equation is valid, there is present in the solution an unvarying quantity of nitrous acid, acting, as it were, catalytically. Analyses of portions of the solution drawn off close to the surface of the mercury give support to the foregoing theoretical considerations. When working at 35°, the mercurous nitrite and mercurous nitrate are present in molecular proportion.

The basic constitution of Marignac's mercurous nitrates is traced to the behaviour of mercuric nitrite, which is itself derived from mercurous nitrite (*Trans.*, 1904, **85**, 523). The production of hemi-hydroxy-mercurous nitrate is explained by the following equation: $2Hg_2(NO_3)_2 + 2Hg + Hg_2(NO_2)_2 + 2H_2O = 4HO{\cdot}Hg_2NO_3 + 2NO$.

Two oxy-mercurosic nitrates, one orange-yellow and the other lemon-yellow, the latter best known through Gerhardt's work, the former a salt obtained by the author, are both traced to their origin from mercurous nitrite through the agency of mercuric nitrite. Direct oxidising action, whether by nitric acid or by air, is demonstrated to be at least unnecessary for the production of the mercuric and mercurosic nitrates which result from the prolonged changes occurring in a nitric acid solution of mercury.

***191. "Amidechloroiodides." By George Druce Lander and Harry Edwin Laws.**

When pure dry hydrogen iodide is passed into a solution of benzanilide imidechloride in light petroleum, an amidechloroiodide, probably having the constitution $Ph{\cdot}CClI{\cdot}NHPh$, is precipitated as

a microcrystalline, yellow powder (m. p. 106° with decomposition). A similar result is obtained with the imidechloride of benzo-*p*-toluidide.

With arylamines and sodium alkyloxides, amidines and imino-ethers respectively are formed, the chloroiodides first losing hydriodic acid and the imidechlorides then reacting in the usual way. As the iodine atom is not capable of giving reactions of substitution no direct evidence in support of the given constitution can be adduced, but the compounds are analogous in physical properties and chemical behaviour to Biltz's amideiodides, $RCI_2 \cdot NH_2$.

Benzamidedi-iodide, $PhCI_2 \cdot NH_2$, can be easily prepared by means of dry hydrogen iodide instead of the concentrated aqueous solution used by Biltz. Benzonitrile is formed from it by the action of alcoholic sodium ethoxide.

192. "A new synthesis of *iso*caprolactone and certain derivatives." By David Trevor Jones and George Tattersall.

***iso*Caprolactone** may be easily obtained by the action of magnesium methyl iodide on ethyl lævulate in ethereal solution, the yield being 30 per cent.

$$CH_3 \cdot CO \cdot CH_2 \cdot CH_2 \cdot CO_2Et \longrightarrow CH_3 \cdot C(OMgI)(CH_3)_2 \cdot CH_2 \cdot CH_2 \cdot CO_2Et \longrightarrow$$
$$C(OH)(CH_3)_2 \cdot CH_2 \cdot CH_2 \cdot CO_2Et \longrightarrow C(CH_3)_2 \begin{<}{\scriptstyle CH_2 \atop O \cdot CO}\end{>} CH_2.$$

On treating *iso*caprolactone with phosphorus pentabromide in the cold and pouring the product into alcohol, *ethyl γ-bromoisocaproate*, $(CH_3)_2CBr \cdot CH_2 \cdot CH_2 \cdot CO_2Et$, is formed, which decomposes on distillation.

Ethyl γ-methylallylacetate, $CH_2{:}CMe \cdot CH_2 \cdot CH_2 \cdot CO_2Et$, obtained by treating ethyl γ-bromo*iso*caproate with diethylaniline at 140° for 10 minutes, is a fragrant, mobile liquid boiling at 85° under 20 mm. pressure.

γ-Methylallylacetic (*γ-methyl-*Δ^{γ}*-pentenoic*) *acid*,

$$CH_2{:}CMe \cdot CH_2 \cdot CH_2 \cdot CO_2H,$$

produced when the preceding ester is hydrolysed with aqueous caustic soda, is a liquid with a pungent odour; it is volatile in steam and polymerises on distillation.

193. **"The influence of substitution in the nucleus on the rate of oxidation of the side-chain. Part II. Oxidation of the halogen derivatives of toluene." By Julius Berend Cohen and James Miller.**

The authors have studied the behaviour of the isomeric chlorobromo- and dibromo-toluenes, and the following table contains a synopsis of the results obtained with these substances and also with the dichlorotoluenes (compare *Trans.*, 1904, **85**, 174), the compounds on the left being least, those on the right most, rapidly oxidised. The bracket indicates an approximately equal rate of oxidation.

Cl·Cl	3·5	2·5	2·6	2·3	2·4	3·4
Cl·Br	3·5	2·5	2·6	2·3	2·4	3·4
Br·Cl.....		2·5		2·3	2·4	3·4
Br·Br.....	3·5	2·3	2·5	2·6	2·4	3·4

The order of oxidation is the same in all three series with the exception of the 2 : 3-dibromotoluene, which follows the 3 : 5- instead of the 2 : 5- and 2 : 6-compounds, as in the other two series.

A comparison of the pairs of chlorobromo-compounds with reversed positions of the halogens indicates that the compound, in which bromine occupies the meta-position, is the less rapidly oxidised of the two.

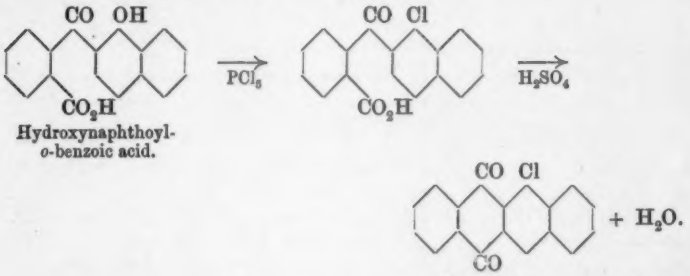
The dibromotoluenes are in all cases less rapidly oxidised than the dichlorotoluenes, and where bromine is in the meta-position the retarding action is much more pronounced than in the other cases.

The position occupied by the chlorobromotoluenes as regards the rate of oxidation is not always midway between the other two series (the dichloro- and dibromo-toluenes), but appears at first sight to be quite irregular; it may be accounted for by the fact that the three monobromotoluenes are much more rapidly oxidised than the three monochlorotoluenes, and if, as appears probable, two different halogens interfere less with each other's individual influence than two similar halogens, the apparent irregularities vanish. The problem is, however, thereby rendered more complex.

The authors propose to introduce the word "*isotopic*" (ἴσος, equal; τόπος, place) to indicate similar compounds substituted in the same positions. Thus the 2 : 3-dichloro-, 2 : 3-chlorobromo-, 3 : 2-chlorobromo-, and 2 : 3-dibromo-toluenes would be "isotopic" substances.

194. "The halogen derivatives of naphthacenequinone." By Samuel Shrowder Pickles and Charles Weizmann.

In the systematic investigation of the halogen derivatives of naphthacenequinone, $C_{18}H_{10}O_2$, the preparation of these compounds by direct bromination or chlorination is not advisable, inasmuch as the separation and identification of the products would be a matter of considerable difficulty. The authors have succeeded in obtaining a monochloro-derivative, in which the position of the chlorine atom is defined by first treating hydroxynaphthoyl-*o*-benzoic acid with phosphorus pentachloride, thus obtaining a chloronaphthoyl-*o*-benzoic acid. On treating this acid with concentrated sulphuric acid, water is eliminated and chloronaphthacenequinone is produced.



Hydroxynaphthoyl-*o*-benzoic acid.

Chloronaphthacenequinone.

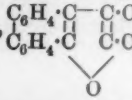
195. "The constitution of pyrazolidone derivatives: β-phenylazo*iso*-valeric acid and *s*-β-phenylhydrazidobutyric acid." By Bertram Prentice.

When 1-phenyl-3 : 3-dimethyl-5-pyrazolidone (m. p. 74—75°) is hydrolysed with barium hydroxide, β-phenylazo*iso*valeric acid (m. p. 57—58°) is produced (*Annalen*, 1896, **292**, 272). When treated with reducing agents in acid solution, β-phenylazo*iso*valeric acid yields 1-phenyl-3 : 3-dimethyl-5-pyrazolidone, which is formed by the condensation of the intermediate β-phenylhydrazido*iso*valeric acid.

1-Phenyl-3-methyl-5-pyrazolidone, prepared according to Knorr and Duden's method (*Ber.*, 1893, **26**, 103), was also hydrolysed, and yielded *s*-β-phenylhydrazidobutyric acid, $C_6H_5{\cdot}NH{\cdot}NH{\cdot}CH(CH_3){\cdot}CH_2{\cdot}CO_2H$ (m. p. 96—97°), an unstable substance with strong reducing properties, which on fusion loses 1 molecule of water and becomes converted into 1-phenyl-3-methyl-5-pyrazolidone (m. p. 84—85°).

196. "**Preliminary notice of some condensations of phenanthraquinone with ketonic compounds.**" By Francis Robert Japp and James Wood.

Very few condensations of this class have hitherto been studied, and in these only alkaline condensing agents have been employed; but in many cases such agents give no result. The authors find, however, that acetic anhydride containing a little sulphuric acid frequently brings about the desired reaction.

Thus a mixture of phenanthraquinone and acetophenone yields, with this reagent—slowly at the ordinary temperature, more rapidly at 40°—*3-acetoxy-2-phenyl-4:5-diphenylenefurfuran*,  , which crystallises from benzene in slender needles (m. p. 232°).

With phenanthraquinone and ethyl benzoylacetate, on the other hand, *ethyl diphenylenedibenzoylmuconate* (*ethyl βγ-diphenylene-αδ-dibenzoylbutadiene-αδ-dicarboxylate*),

$$\begin{matrix} C_6H_4\cdot C\cdot C(CO\cdot C_6H_5)\cdot CO_2\cdot C_2H_5 \\ C_6H_4\cdot C\cdot C(CO\cdot C_6H_5)\cdot CO_2\cdot C_2H_5' \end{matrix}$$

is obtained, the acetic anhydride in this case furnishing no part of the resultant molecule. This substance crystallises from benzene in rectangular plates with bevelled edges. It softens and almost melts between 170° and 174°, but immediately resolidifies, finally melting sharply at 223°. This phenomenon is due to the transformation of the condensation compound into an isomeride, which crystallises from acetic acid in slender needles melting at 223·5°.

Under the foregoing conditions, phenanthraquinone also yields condensation products with ethyl acetoacetate, ethyl malonate, and analogous compounds.

The authors wish to reserve the study of these various condensations.

197. "**The decomposition of ethylene iodide under the influence of the iodide ion.**" By Arthur Slator.

The following is a summary of the results obtained:

(1) Ethylene iodide in aqueous-alcoholic solution decomposes quantitatively in the presence of potassium iodide, yielding ethylene and iodine.

(2) The velocity of reaction is proportional to the concentration of ethylene iodide and also to that of the iodide ion, showing that the potassium iodide takes some direct (or catalytic) part in the reaction. The temperature quotient for 10° is 2·5.

(3) This reaction is distinct from that between ethylene iodide and sodium thiosulphate, for the two reactions may be superimposed without any great mutual interference.

(4) The rate of liberation of iodine from solutions of methyl iodide, *iso*propyl iodide, and ethyl iodoacetate is accelerated by the addition of potassium iodide.

(5) Ethylene bromoiodide in presence of potassium iodide liberates iodine according to the equation : $C_2H_4IBr + KI = C_2H_4 + I_2 + KBr$.

(6) The reaction velocity is proportional to the concentration of the bromoiodide and also to that of the potassium iodide, and the temperature quotient for 10° is 2·45.

Ethylene iodide is probably not an intermediate product in the reaction. The iodide decomposes about three times as fast as the bromoiodide.

198. "The spectrum generally attributed to 'chlorophyll' and its relation to the spectrum of living green tissues." By Walter Noel Hartley.

The author formerly showed (*Trans.*, 1891, 59, 106) that the alcoholic extract of fresh green leaves and also the alcoholic extract of dried leaves do not give the same absorption spectrum as the material in the living leaf when examined under normal conditions. This difference was believed to be due either to the formation or the occurrence of acid in the extract and in the dried leaves, this acid effecting chemical changes in the colouring matter. The same changes in the spectrum could be brought about in the living leaf in an oxidising atmosphere under the action of intense sunlight, and these are conditions which would lead to the formation of an acid.

Marchlewski and Schunck (*Trans.*, 1900, 77, 1080) cast doubt on the accuracy of the author's observations, and more particularly on the efficiency of the process described for extracting the bluish-green colouring matter, Sorby's "blue chlorophyll," in an unchanged condition from an alcoholic extract of green leaves. The author therefore found it desirable to have the process re-examined by an independent observer, and subsequently he repeated the experiments himself. Further measurements of spectra are recorded which confirm the accuracy of the original observations.

199. "Studies on comparative cryoscopy. Part II. The aromatic acids in phenol solution." By Philip Wilfred Robertson.

As in the case of the fatty acids, an intimate relationship is shown between the association and the velocity of esterification ; those acids which are most difficult to esterify associate the least.

Substitution in the ortho-position with respect to the carboxyl group reduces the "rate" of association. The substituent groups or atoms may be arranged in the following order: OH, CH_3, Cl, Br, NO_2. The lighter groups exert only a slight influence, but there is a marked diminution in the case of the heavier groups.

In the case of acids containing two ortho-substituents, however, there is practically no association, whether the substituent is heavy or light. Compounds of this nature are characterised by the fact that they yield esters only with the greatest difficulty, whereas the velocity of esterification of the ortho-substituted benzoic acids is dependent on the weight of the substituting group or atom.

Substitution of the nitro-group in the meta-position still causes a reduction in the "rate" of association, but a lighter group, like methyl, has no influence in this position.

The hydroxylic and dibasic acids are characterised by their sparing solubility in phenol.

200. **"Isomeric change of diacylanilides into acylaminoketones. Transformation of dibenzoylaminobenzophenone into 1-benzoylamino-2:4-dibenzoylbenzene." By Frederick Daniel Chattaway and William Henry Lewis.**

It has recently been shown (*Trans.*, 1904, 85, 386, 499) that diacyl derivatives of aromatic amines can undergo an intramolecular rearrangement whereby an acyl group leaves the nitrogen and enters the nucleus in an ortho- or a para-position with respect to this element. The transformation of such diacylamino-derivatives can progress beyond the first stage, so that two groups may enter the ring in positions probably ortho- and para- to the nitrogen. The isolation of 1-amino-2:4-dibenzoylbenzene from the product obtained by heating aniline (1 mol.) with benzoyl chloride (3 mols.) was described.

ERRATUM.

PROC., 1904, p. 199.

Line 1, *after* "permanganate" *insert* "in the presence of potassium persulphate."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 5th, 1904.

At the next Meeting, on Thursday, December 1st, 1904, at 8 p.m., there will be a ballot for the election of Fellows, and the following paper will be communicated :

"The nitrites of the alkali metals and metals of the alkaline earths and their decomposition by heat." By P. C. Rây.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Guttmann, Leo F. Percentage tables for elementary analysis. pp. vii + 43. London 1904. From the Author.

Meldola, Raphael. The chemical synthesis of vital products and the inter-relations between organic compounds. Vol. I. Hydrocarbons, alcohols and phenols, aldehydes, ketones, carbohydrates and glucosides, sulphur and cyanogen compounds, camphor and terpenes, colouring-matters of the flavone group. pp. xvi + 339. London 1904. From the Author.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome I. ii. Métalloïdes. Tome II. ii. Métaux. Paris 1904. From Professor Henri Moissan.

II. *By Purchase.*

Bischoff, C. A. Materialien der Stereochemie in Form von Jahresberichten, 1894—1902. 2 vols. pp. cxxxvi + 1977. Braunschweig 1904.

Donath, Eduard. Der Graphit. Eine chemisch-technische Monographie. pp. 175. ill. Leipzig 1904.

Engler, C., und Weissberg, J. Kritische Studien über die Vorgänge der Autoxydation. pp. xi + 204.

Lafar, Franz. Handbuch der technischen Mykologie. Zweite Auflage. Erste Lieferung. ill. Jena 1904.

Roozeboom, H. W. Bakhuis. Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Heft 1. Die Phasenlehre-Systeme aus einer Komponente. Heft 2. i. System aus zwei Komponenten. pp. xiii + 221, xii + 467. ill. Braunschweig 1904.

III. *Pamphlets.*

Dyer, Bernard. The manuring of hops. (From the *Brewing Trade Review*, 17, 1903.)

Dymond, T. S., and Bull, B. W. On tillage crops. (Essex Field Experiments, No. 2.) Chelmsford 1903.

Grindley, H. S., and Mojonnier, Timothy. Experiments on losses in cooking meat, 1900—1903. (U.S. Dept. of Agric. Office of Experiment Stations, Bulletin No. 141.)

Harding, H. A., and Nicholson, J. F. A swelling of canned peas accompanied by a malodorous decomposition. (New York Agric. Exper. Station, Bulletin No. 249.)

Henderson, G. G. Some developments in chemical theory during the nineteenth century. (From the *Proc. Roy. Phil. Soc. Glasgow*, 35, 1904.)

Hooper, David. Silajit: an ancient Eastern medicine. (From the *Journal of the Asiatic Society of Bengal*, 72, 1903.)

Hooper, David. The occurrence of Melanterite in Baluchistan. (From the *Journal of the Asiatic Society of Bengal*, 72, 1903.)

Jordan, W. H., and Fuller, F. D. Inspection of feeding stuffs. (New York Agric. Exper. Station, Bulletin No. 240.)

Kebler, Syman F. Adulterated drugs and chemicals. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 80.) 1904.

New Zealand, Mines Department. Thirty-seventh annual report of the Colonial Laboratory. By J. S. Maclaurin. pp. 30. Wellington 1904.

Page, Logan Waller, and Cushman, Allerton S. The testing of road materials. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 79).

Patten, A. J., and Hart, E. B. The nature of the principal phosphorus compound in wheat bran. (New York Agric. Exper. Station, Bulletin No. 250.)

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 1st, 1904.

Allen, William Harold Richard,

c/o Straits Trading Co., Butterworth, Penang, S.S.

Assayer to the Straits Trading Company's Penang Smelting Works. Studied Chemistry for four years under Dr. Wm. Norman Bott, then Government Analyst and Science Lecturer, Straits Settlements; part time assisting in his laboratory, since which (*i.e.* for past 7 years) have been in the Straits Trading Company, and am now head of their Penang Laboratories, where have done much Research Work on Tin.

W. Norman Bott.	George T. Holloway.
James W. Epps.	*E. G. Clayton.*
L. C. Deverell.	*F. M. Mercer.*

Bentley, Walter Henry,

18, Oaten Hill, Canterbury.

Science Master, Simon Langton Schools, Canterbury. B.A., Merton College, Oxford. Second Class Honours in Chemistry. Chemistry Master at the Simon Langton Schools since Sept. 1902.

John Watts.	Allan F. Walden.
W. W. Fisher.	*H. L. Bowman.*
J. E. Marsh.	*R. de J. Fleming-Struthers.*

Black, John Wyclif,

20, Mardale Crescent, Edinburgh.

Analytical Chemist. Principal Assistant to the late Dr. A. P. Aitken. Lecturer on Practical Chemistry, Royal Dick Veterinary College, Edinburgh, and Demonstrator in Pract. Agricultural

Chemistry, Edinburgh University. Acting Chemist to the Highland and Agricultural Society of Scotland and the Turriff and Garioch Analytical Association, Aberdeenshire.

George McGowan.	*J. Falconer King.*
Stevenson Macadam.	*J. A. Voelcker.*
Samuel Walker.	*James Hendrick.*
G. H. Gemmell.	*J. Alan Murray.*

Busher, Thomas Story,

Queen's College, Oxford.

Student. Special study of Science generally, and Chemistry in particular, for 5 years. Queen's Prizeman in Theoretical Inorganic Chemistry, 1899. Hastings Exhibitioner in Natural Science, Queen's Coll., Oxford, 1899. Bachelor of Arts, with Honours; 2nd Class, Final School of Natural Science (Chemistry), Oxford, 1903. I wish, by means of the publications of the Society, to keep in touch with modern chemical thought and progress.

W. W. Fisher.	*John Watts.*
Allan F. Walden.	*T. Vipond Barker.*
J. E. Marsh.	*R. de J. Fleming-Struthers.*

Caldecott, Lawrence,

47, Woburn Place, Russell Square, W.C.

Schoolmaster. I am keenly interested in Chemical Science, and wish to keep in touch with modern chemical advances by obtaining use of the publications of the Society. I have been working at Univ. Coll. since January, and propose to take up Research Work at the end of the year.

J. Norman Collie.	A. W. Stewart.
Samuel Smiles.	Oscar J. Cole.

Chas. H. Lockitt.

Caldwell, Robert John,

49, Merritt Road, Crofton Park, S.E.

Demonstrator, Department of Chemistry, Central Technical College, S.W. Bachelor of Science (London). A.C.G.I. Published 3 papers (2 in conjunction with Dr. E. F. Armstrong, Ph.D., F.C.S.) in *Proc. Roy. Soc.*, 1904. Late Chemist to British Explosives Syndicate, Ltd., Glasgow, and Pitsea, Essex.

Henry E. Armstrong.	T. Martin Lowry.
Gerald T. Moody.	E. Frankland Armstrong.
William A. Davis.	William Robertson.

Clark, Peter Skinner,

Cape Town, Cape Colony, South Africa.

Medical profession and Public Health. M.B., Ch.M.; late Assistant Demonstrator in Materia Medica and Pharmacy, University of Glasgow. Reason for desiring election, to assist in promotion of Chemical Science (especially in regard to Public Health) in Cape Colony.

G. G. Henderson.	*Thomas Gray.*
W. Carrick Anderson.	*A. Humboldt Sexton.*
John Ferguson.	*Matthew A. Parker.*

Clarkson-Harold, Frederick,

10, Fee's Terrace, Longford, Ireland.

Analyst to Messrs. J. & J. Lonsdale & Co., Ltd., Longford. Late Student of Cheshire County Council Agric. College and Univ. College, Reading. Co-worker with Dr. W. F. Sutherst in researches on "Available phosphoric acid in manures and its estimation," "The reversion of superphosphate of lime in the soil," "Effect of lime on the insoluble phosphates in soils," &c., &c.

Edric Druce.	*Henry J. S. Sand.*
John Hughes.	*Arthur Slator.*
George Tate.	*R. M. Caven.*

C. W. Walker-Tisdale.

Cooper, Jabez Horace,

13, Victoria Terrace, Exeter.

Science Master, Exeter Grammar School. Scholar in Chemistry at Jesus College, Oxford. First Class Honours in Chemistry, Honour School of Natural Science, Oxford, 1903. Exhibitioner in Chemistry, London Intermediate B.Sc.

W. W. Fisher.	W. H. Lewis.
John Watts.	J. E. Marsh.
P. Elford.	N. V. Sidgwick.

Cornthwaite, Robert,

Agricultural Laboratory, Halifax.

Agricultural Chemist and Analyst. Analyst to the West Riding Farmers' Association. Investigator and Lecturer on Agriculture and Milk Analysis. Formerly Student under Prof. Ingle, late of the Yorkshire College and the West Riding County Council Experimental Farm.

Fredk. J. Lloyd.	John A. Dewhirsst.
Jas. Proude.	Alfred Sibson.

Edgar M. Chapman.

Crabb, William,

The Grammar School, Penistone, Yorks.

Chemistry Master. Associate of, and late "Capper Pass" Metallurgical Scholar at, University College, Bristol. B.Sc. (Lond.), 1st Division, in Chemistry, Physics, and Pure Mathematics. Wish to keep in touch with modern developments of Chemistry, with a view to taking up research work later on.

Sydney Young. Ernest Bowman Ludlam.
Francis E. Francis. *W. A. Shenstone.*
F. Wallis Stoddart.

Cunningham, James Edward,

21, Blenheim Gardens, Willesden Green, N.W.

Analyst. June 1897—Sept. 1898, Assistant to Ed. Riley, Esq., F.I.C., F.C.S., City Road. Sept. 1898—Dec. 1900, Assistant Chemist to the Ebbw Vale Steel and Iron Co. Oct. 1901—June 1904, at the Royal College of Science, obtaining the Associateship in June 1904 (Chemistry).

William A. Tilden. G. T. Morgan.
M. O. Forster. Chapman Jones.
James C. Philip.

Dalton, William Herbert,

85, Hayter Road, Brixton Hill, London, S.W.

Consulting Geologist (late of H.M. Geological Survey (17 years); 40 years' study of chemical principles in application to geological problems; and desirous of use of the Chem. Soc. Library for works not in that of the Geological Society.

David Howard. Boverton Redwood.
John Heron. Bernard Dyer.
Horace T. Brown.

Deane, Harold,

34, Drakefield Road, Upper Tooting, S.W.

Pharmaceutical Chemist. B.Sc. (Lond.). For the past three years Demonstrator of Chemistry in the Pharmaceutical Society's School. Associate of the Institute of Chemistry.

J. Norman Collie. Herbert Jackson.
W. Palmer Wynne. M. Carteighe.
T. E. Wallis.

Dickinson, Francis,

26, O'Connell Avenue, Berkeley Road, Dublin.

Analytical Chemist. Was educated at the Manchester Grammar

School and the Owens College, Manchester. Engaged as assistant for 4 years to J. Carter Bell, Esq., F.I.C., A.R.S.M., Public Analyst for Salford, &c.; and have for over 3 years been Head Assistant to Prof. Chas. R. C. Tichborne, F.I.C., &c. Public Analyst to the County of Longford, &c. Am also Junior Demonstrator at the Pharmaceutical School of Chemistry, Dublin.

Chas. R. C. Tichborne. — Frank Scudder.
J. Carter Bell. — Robert Pettigrew.
Francis Jones.

Evans, Edward,

33, Ranelagh Road, Westminster, S.W.

Chemist to Chief Engineer of South Metropolitan Gas Co., Old Kent Road, S.E. 7 years' experience with research and working of gas manufacture processes and the recovery of by-products.

J. Tcherniac. — *Robert Hellon.*
Otto Hehner. — *Oscar Guttmann.*
H. F. Brand. — *B. E. R. Newlands.*
W. F. Eichenauer.

Evans, John,

Public Analyst's Laboratory, 67, Surrey Street, Sheffield.

Analytical Chemist. Studied for 2 years at the Pharmaceutical Society's Laboratories under Professor J. Norman Collie (1897—1899), Jacob Bell Scholar, 1897. Two years at King's College, London, under Professor J. M. Thomson. Associate of the Institute of Chemistry (A.I.C). At present and for the last three years assistant to Mr. Alfred H. Allen, of Sheffield.

J. Norman Collie. — Herbert Jackson.
Arthur Lapworth. — Patrick H. Kirkcaldy.
John M. Thomson. — G. E. Scott-Smith.
Arnold R. Tankard.

Fagan, Thomas Wallace,

Harper Adams Agricultural College, Newport, Salop.

Lecturer in Chemistry (Pure and Applied) at the Harper Adams Agricultural College. Graduate of Cambridge University with Honours in Chemistry; in my reading am constantly referred to contributions and articles in the Society's Journal, and am anxious to become a Fellow so that I might have copies of the Society's publications.

R. S. Cahill. — Hubert Thompson.
C. E. Womersley. — Edric Druce.
A. Peacock.

Forrest, John Kerr,

Hawsleigh, Balaclava Road, St. Kilda, Victoria.

Manufacturing Chemist. Studied Chemistry under the late Dr. Stevenson Macadam in Edinburgh, also under Prof. Hartley and Dr. Muter in London. Have had 14 years' experience in laboratory work as Manufacturing Chemist, and 18 years as Manager of Chemical Works. Qualified as Chemist and Druggist in 1874. President of Victorian Society of Chemical Industry, 1904.

Fred. W. Steel. D. Avery.
Orme Masson. A. W. Craig.
Frederic Dunn.

Henzell, Archie Willoughby,

Witton Hall Industrial School, Birmingham.

Schoolmaster [Head]. Adv. Chem. (Bd. of Educ.) Teacher's Certificate. Studied Boro' Polytechnic; Univ. Coll., Liverpool; Leicester Tech. School, and Wyggeston School, Leicester.

F. Mollwo Perkin. Alexander M. Chance.
J. Gale. *R. J. Friswell.*
R. L. Barnes. *Rudolph Messel.*
A. E. Beanes.

Hodgson, Thomas Reginald,

The Sycamores, Poulton-le-Fylde, Lancashire.

Student in Chemistry. Student in Chemistry for Part II of the Natural Sciences Tripos at Cambridge University.

Charles T. Heycock. H. J. H. Fenton.
W. J. Sell. F. W. Dootson.
H. O. Jones. *A. Hutchinson.*
G. D. Liveing.

Horrod, George William Thomas,

294, Brixton Hill, London, S.W.

Chemist. Analytical Chemist to The Associated Portland Cement Manufrs. (1900), Ltd., Central Laboratory, Gravesend, Kent. Qualified Chemist of the Pharmaceutical Society.

E. J. Read. Edward Horton.
Frank B. Gatehouse. Frank E. Weston.
H. K. G. Bamber.

Inglis, John Kenneth Harold,

University College, London.

Assistant (Chemical Dept.), M.A., B.Sc. (New Zealand), B.Sc. (Edinb.). (1) Action of Ammonium Salts on Solutions of Amm.

Persulphate, *Proc. R.S.E.*, 1902, in conjunction with Hugh Marshall, D.Sc. (2) A Suggested Theory of the Aluminium Anode, *Phil. Mag.*, 1903, in conjunction with W. W. Taylor, D.Sc. (3) Ozon als Oxydations-mittel (with R. Luther), *Zeit. physikal. Chem.*, 1903. (4) Notes on Ozone, &c., *J. C. S.*, 1903. (5) Bemerkungen zur Elektrochemie der Uebermangansäure, *Zeit. Elektrochem.*, 1903.

William Ramsay. Edward C. Cyril Baly.
J. Norman Collie. Samuel Smiles.
N. T. M. Wilsmore.

James, Thomas Campbell,
4, Belmont Terrace, Llanelly.

Demonstrator in Chemistry at Univ. Coll. of Wales, Aberystwyth. B.Sc. University of Wales in Chemistry and Physics. 1st Class Nat. Sci. Tripos, Part I, Cambridge. 2nd Class in Chemistry and Physics Nat. Sci. Tripos, Part II. B.A. of Trinity College, Cambridge.

G. D. Liveing. F. W. Dootson.
W. J. Sell. H. O. Jones.
H. J. H. Fenton. J. J. Sudborough.

James, Walter Richmond,
49, Wednesfield Road, Wolverhampton.

Assayer and Metal Refiner. Student of Metallurgy, University, Birmingham. Formerly Student at Wolverhampton Technical School, taking Honours in Chemistry and Metallurgy.

Thomas Turner. Frank E. Thompson.
Wm. Whitehouse. *Alex. Findlay.*
Alex. McKenzie.

Johnson, John Richard,
Apothecaries' Hall, London, E.C.

Pharmaceutist. Pharmaceutical Chemist and Member of Pharmaceutical Society. Late Government Analytical Chemist in Jamaica, British West Indies, 1899—1900. Undergrad. Lond. University Inter. Science; Intermediate Exam. Institute of Chemistry.

W. Palmer Wynne. Peter MacEwan.
Bernard Dyer. John Castell-Evans.
R. Meldola. F. Southerden.

Jones, Horace Francis,
3, Kerry Crescent, Calne, Wilts.

Assistant Master County School, Calne, Wilts. Assistant Science Lecturer, County School, Calne. Science Lecturer (includes Chemistry),

Pupil Teachers' Centre, Calne. Assistant Instructor and Lecturer, Wilts. County Council Nature Study Courses.

Frank Dixon. *Lawrence W. Mathieson.*
J. Murray Crofts. *W. R. Bird.*
C. H. Corbett. *Thomas C. Davison.*

Jones, William App,
12, E. 18th Street, New York City.

Chemist. A.B. 1893. A.M. 1897. Wake Forest College, N.C. Ph.D., 1898, Johns Hopkins Univ., Baltimore. Scholar 1896 and 1897 Johns Hopkins Univ., Baltimore. Fellow, 1898, Johns Hopkins Univ., Baltimore. 1898, "Study of cuprous chloride—carbon monoxide." 1903, "Action of ozone, &c., on carbon monoxide."

Ira Remsen. Edward C. Worden.
Benj. L. Murray. *R. C. Woodcock.*
Virgil Coblentz.

Joseph, Alfred Francis,
95, Marylands Road, Maida Vale, W.

Lecturer on Chemistry, Wimbledon College, S.W. For 6 years (1896—1902) teaching assistant and lecturer in Chemistry at the Regent Street Polytechnic. Associate of the Royal College of Science (Lond.) in Chemistry, 1st class (Course 1902—1904). At present, lecturer as above.

William A. Tilden. James C. Philip.
Chapman Jones. G. T. Morgan.
M. O. Forster.

Lauder, James Stanley,
c/o B. Harvey, Qu'Appelle, N.W.T. Assa., Canada.

Analytical Chemist. I have been under Prof. J. R. Watson, M.A., Public Analyst, Andersons College Medical Sch., Dumbarton Rd., for four years as his assistant. Since leaving College, I have been on research with "Acetylene Gas," for which I am taking out a patent.

A. Humboldt Sexton. R. T. Thomson.
R. R. Tatlock. *G. G. Henderson.*
Thomas Gray.

Levy, Arthur Garfield,
c/o Bertram Blount, Esq., 76, York Street, Westminster.

Assistant to Mr. Bertram Blount. Bachelor of Science (London). Associate of the Institute of Chemistry. Certificated Student of the Technical College, Finsbury, Chemical Department.

Bertram Blount. John Castell-Evans.
Herbert Jackson. Lewis Eynon.
R. Meldola. F. Henry Streatfeild.
Patrick H. Kirkcaldy.

Longstaff, James Patrick,

19, Fettes Row, Edinburgh.

Assistant, Chemistry Department, The University, Edinburgh. B.Sc. (Edin.) with "special distinction" in Chemistry. Vans Dunlop Scholar, 1897—1900. Formerly Demonstrator in Heriot-Watt College, Edinburgh. "Ammonium molybdate as a delicate reagent for stannous chloride" (*Chem. News*, 1899, 282).

Alex. Crum Brown. J. Gibson.
Leonard Dobbin. Bertram D. Steele.
Hugh Marshall. Alexander Lauder.

McDougall, Arthur Thomas,

3, Albion Road, College Park, London, S.E.

Senior Science Master, Deptford Pupil Teachers' Centre. B.A. (Lond.), Int. B.Sc. (Lond.). 2 years student in Honours Classes at Carpenter Co.'s Institute, Stratford. 6 years Science Master at Deptford P.T. Centre.

William Ping. Edgar E. Horwill.
W. A. Rugginz. *Arthur H. Coote.*
A. W. Harvey.

Mathews, Harold Joseph Clarke,

Massey's Burnley Brewery, Ltd., Burnley, Lancs.

Brewer and Analytical Chemist. Honours Stage in Inorganic and Organic Chemistry (Sci. and Art Dept.); 1st Class Honours, and 1st Prize Silver Medal and Money Prize in Brewing (City and Guilds of London Institute).

William J. Pope. F. S. Sinnatt.
Jas. Grant. Stanley J. Peachey.
L. G. Radcliffe.

Millar, Ernest Westby,

Windsor, Monkstown, Co. Dublin.

Student of Chemistry. For 3 years studied at the Royal College of Science, Dublin, of which he is an Associate, and also at University College, London, for 2 years.

J. Norman Collie. Edward C. Cyril Baly.
Samuel Smiles. A. W. Stewart.
Alex. W. Bain.

Phillips, George Frederick,

"Tonbridge," Colworth Road, Leytonstone.

Lecturer in Chemistry to the Ilford Council. Bachelor of Science

(Lond.). Third year student by election at Boro' Road College. "Triarian" Special Merit Certificate for Science.

G. T. Morgan. Thomas L. D. Porter.
H. Burrows. *Chapman Jones.*

M. O. Forster.

Rouillard, Marie Jean Louis Ernest,
Malvern, Natal.

Analyst. B.Sc. (Edin.). Student in Analytical Chemistry under Falconer King and Hunter, Edinburgh; was Analytical Chemist in Mauritius for four years with Planters Chemical Manure Co., Ltd. At present Assistant to Public Analyst, Durban, Natal.

H. H. C. Pentan. J. S. Jamieson.
W. H. Pay. A. Pardy.

E. Nevill.

Spielmann, Percy Edwin, A.R.C.S.,
21, Cadogan Gardens, S.W.

Student. Associate of the Royal College of Science. Student at the University College, Gower Street. Desirous of keeping in touch with the progress of Chemistry.

William A. Tilden. Chapman Jones.
M. O. Forster. G. T. Morgan.

James C. Philip.

Stanley, Harry,
The Park, Southend Village, Catford, S.E.

Mathics. and Chem. Tutor. B.Sc. (London). First in order of merit in Honours, Part II, Brd. of Education Chem. Exam. for year 1903. For last 4 years Student at Merchant Venturers' Tech. Coll., Bristol. Desirous of keeping in touch with present day research.

Bevan Lean. G. P. Darnell-Smith.
J. Wertheimer. A. J. Carrier.

Frank B. Gatehouse.

Sutcliffe, Thomas,
19, Rhodes Street, Halifax, Yorks.

Schoolmaster. 3 years Student at Higher Grade School, Halifax. (Analytical Chemistry); 1 year Student at The Tech. Sch., Halifax, Teacher: W. Ackroyd, F.I.C., F.C.S.; 2 terms Student at the Grammar School, Tideswell (under W. G. Boul, M.A., D.C.L., LL.D., F.C.S.). Teacher of Chemistry at Pellon Bd. Sch., Halifax. Teacher

of Chemistry at the Grammar Sch., Elland. Reason: that I may keep in touch with Chemical Research, and thus teach the subject more intelligently.

W. G. Boul. C. E. Womersley.
W. Ackroyd. *A. Peacock.*
R. S. Cahill. *F. W. Richardson.*

Thibault, Paul John,
Howell, N.S.W., Australia.

Metallurgical and Analytical Chemist and Assayer. Have practised for a period of thirteen years as a Metallurgical and Analytical Chemist and Assayer, seven years of which were spent as an assistant and student, and six years as a senior man in charge of various laboratories.

Alexander Orr. Will. A. Dixon.
James Taylor. *J. A. Schofield.*
F. B. Guthrie.

Tonkin, Arnold Bertram,
Durban, Natal.

Assistant in the Government Laboratory, Natal. Studied at Penzance School of Mines, 1896—1899. Appointed Assistant in Natal Govt. Laboratory, May 1st, 1902. Am desirous of becoming a member of the Society, in order that I may benefit by the use of the Society's publications.

E. Nevill. J. S. Jamieson.
W. H. Pay. A. Pardy.
H. H. C. Puntan.

Twiss, Douglas Frank,
89, Wood Lane, Harborne, Birmingham.

Lecturer in Chemistry. 1902, Honours B.Sc. at University of Birmingham (awarded University Scholarship); 1903, M.Sc. Degree at University of B'ham.; 1903—1904, Priestley Research Scholar at University of B'ham. Recently appointed Chemistry Lecturer at Birmingham Municipal Technical School.

Percy F. Frankland. Alex. McKenzie.
T. Slater Price. Alex. Findlay.
W. E. S. Turner.

Watson, Edwin Roy,
1, Fair Street, Cambridge.

Student. B.Sc. London, 1st Class Honours in Chemistry. B.A., Cambridge Nat. Science Tripos, Parts I and II. Late member of

Bathymetrical Survey of Scottish Fresh Water Lochs. S. Ruhemann and E. R. Watson, "Contribution to the knowledge of the β-diketones" (*Trans.*, 85, 456).

S. Ruhemann. R. S. Morrell.
M. M. Pattison Muir. Charles T. Heycock.

F. H. Neville.

Watson, Herbert Wood,
111, Brudenell Road, Hyde Park, Leeds.

Analytical Chemist. Studied from 1893 to 1896 at Yorkshire College, taking degree of B.Sc. in Honours School of Chemistry of Victoria University in 1896. From 1896 to 1903, chief assistant to Messrs. Murphy & Lonsdale, Leeds, Brewers, Chemists, &c., and at present Chemist and Bacteriologist to Messrs. Joseph Hobson & Son, Spruce Beer and British Wine Manufacturers, Dantzic Works, Leeds. First Class Honours in Brewing (City and Guilds Exam.). Associate of Yorkshire College. Member of Institute of Brewing, and of Society of Chemical Industry.

Arthur Smithells. *Thomas Fairley.*
Julius B. Cohen. *Alfd. C. Chapman.*
A. J. Murphy. *John Heron.*

Arthur R. Ling.

Weeks, Henry Bridges,
The Retreat, Infield Park, Barrow-in-Furness.

Chemist and Metallurgist. Fellow of the Institute of Chemistry; Member of Society of Chemical Industry; Member Iron and Steel Institute; Chemist and Metallurgist, Vickers, Sons & Maxim, Ltd. Formerly Chemist and Metallurgist, Govt. of India (Ordnance Dept.).

L. Archbutt. J. C. Aylan.
R. J. Redding. Wesley Lambert.

Ernest A. Lewis.

Willcox, William Henry,
St. Mary's Hospital, Paddington, W.

Lecturer on Pathological Chemistry and Practical Toxicology, St. Mary's Hospital, W. Degrees, &c.: B.Sc. (Lond. Univ.); Fellow of Inst. of Chemistry; M.D., (Lond. Univ.); D.P.H.; London University Gold Medallist and Exhibitioner in Organic Chemistry, Materia Medica and Pharmaceutical Chemistry, and Forensic Medicine. Appointments: Lecturer on Chemistry, Queenwood College, Hants, 1893—1895; "Scientific Analyst to the Home Office"; Lecturer on Chemistry, St. Mary's Hospital, London, 1900—1904; Lecturer on Pathological Chemistry, St. Mary's Hospital (now held). Research

Work: Researches on Bran Fermentation (*Jour. Soc. Chem. Industry*), May, 1893. On a pure cultivation of a bacillus fermenting bran infusion (*J. Soc. Chem. Ind.*, June, 1897). Barium butyrate and the estimation of butyric acid (*Jour. Chem. Soc.*, 1897). Toxicological detection of arsenic and influence of selenium on its tests (*Lancet*, March, 1901). The use of phenylhydrazine in the clinical examination of urine (*Lancet*, 1904).

Thomas Stevenson. Frank Clowes.
Arthur P. Luff. John M. Thomson.
Henry Forster Morley.

Wyeth, Frank John, M.A. Cantab., L.C.P., Int. B.Sc., Lond.
14, Preston Drove, Brighton.

Science Master, Elizabeth College, Guernsey; 1st Class Hons. Natural Science Tripos, Cambridge, 1899; Chem. Research Student, London Univ.; 4 years' experience as Chemistry Master in Public Schools; Official Analyst to the States of Guernsey, 1904.

W. J. Stainer. *F. W. Dootson.*
H. J. H. Fenton. *H. O. Jones.*
John E. Mackenzie. *W. J. Sell.*

The following was recommended by the Council for presentation to ballot under Bye-law I. (3):

Komppa, Gustav,
Polytechnik, Helsingfors.

Professor of Chemistry and Director of the Chemical Laboratories. Author of a large number of original papers dealing especially with the camphor group, and among these may be mentioned the synthesis of both apocamphoric acid and camphoric acid.

W. H. Perkin, jun. *Harold B. Dixon.*
F. Stanley Kipping.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 8/12/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 286.

Thursday, December 1st, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. A. D. Cowper and E. S. Simpson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

Andrea Angel, M.A., 41, Wellington Square, Oxford.
James H. Campbell, 3, Morrison Terrace, North Road, Bellshill, N.B.
Bernard Collitt, 79, Eastbourne Terrace, Gainsborough.
Herbert Goodier, 16, Hall Royd, Shipley.
George Moss Lloyd, M.A., M.Sc., Queen's Road, Rock Ferry.
Thomas Pennycuick, B.Sc., 6, Lorne Street, Fairfield, Liverpool.
Bert Perrott, Ael-y-Bryn, Penywern Road, Neath, Glam.
William Henry Ratcliffe, B.Sc., 18, Wheeler Street, Maidstone.
Frederick George Richards, 21, Dutton Street, Manchester.
Harold Rudolph Rogers, B.A., 75, South Side, Clapham Common, S.W.

The PRESIDENT drew attention to the stand for the display of certificates of candidates for election which had been placed in the Library, and stated that, as the certificates are now printed in full in the "Proceedings," they would not in future be brought down from the Library on the occasion of the ballot.

A Ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

William Harold Richard Allen.
Walter Henry Bentley, B.A.
John Wyclif Black.
Thomas Story Busher, B.A.
Lawrence Caldecott.
Robert John Caldwell, B.Sc.
Peter Skinner Clark, M.B., Ch.M.
Frederick Clarkson-Harold.
Jabez Horace Cooper, B.A.
William Crabb, B.Sc.
James Edward Cunningham.
William Herbert Dalton.
Harold Deane, B.Sc.
Francis Dickinson.
Edward Evans.
John Evans.
Thomas Wallace Fagan, B.A.
John Kerr Forrest.
Archie Willoughby Henzell.
Thomas Reginald Hodgson.
George William Thomas Horrod.
John Kenneth Harold Inglis, M.A., B.Sc.
Thomas Campbell James, B.A., B.Sc.
Walter Richmond James.
John Richard Johnson.
Horace Francis Jones.
William App Jones, Ph.D., A.M.
Alfred Francis Joseph.
Gustav Komppa, Ph.D.
James Stanley Lauder.
Arthur Garfield Levy, B.Sc.
James Patrick Longstaff, B.Sc.
Arthur Thomas McDougall, B.A.
Harold Joseph Clarke Mathews.
Ernest Westby Millar.
George Frederick Phillips, B.Sc.
Marie Jean Louis Ernest Rouillard, B.Sc.
Percy Edwin Spielmann.
Harry Stanley, B.Sc.
Thomas Sutcliffe.
Paul John Thibault.
Arnold Bertram Tonkin.
Douglas Frank Twiss, M.Sc.
Edwin Roy Watson, B.A., B.Sc.
Herbert Wood Watson, B.Sc.
Henry Bridges Weeks.
William Henry Willcox, M.D., B.Sc.
Frank John Wyeth, M.A.

Of the following papers, those marked * were read :

***201. "The nitrites of the alkali metals and metals of the alkaline earths and their decomposition by heat." By Prafulla Chandra Rây.**

Solutions of the nitrites of barium and calcium, like those of the alkali metals, can be safely evaporated to dryness at the boiling temperature without decomposition or oxidation taking place.

A solution of magnesium nitrite prepared by the double decomposition between barium nitrite and magnesium sulphate is perfectly stable at the ordinary temperature, but it cannot be concentrated on the water-bath as it undergoes decomposition even at 60°, evolving nitric oxide. The solution, when concentrated under reduced pressure over sulphuric acid, yields the hydrated salt $Mg(NO_2)_2,3H_2O$, which, when kept in a desiccator, loses only one molecule of water, the dehydration not going any further. All the nitrites described have a faint yellow colour. When barium nitrite is heated under reduced pressure at 225—300°, the following reactions occur :

$$3Ba(NO_2)_2 = 2BaO + Ba(NO_3)_2 + 4NO,$$
$$2Ba(NO_2)_2 = BaO + Ba(NO_3)_2 + NO + N;$$

whereas at temperatures between 300° and 500° or upwards the following change takes place:

$$Ba(NO_3)_2 = BaO + 2NO_2 + O_2.$$

The other nitrites behave similarly. In the earlier stages, the gaseous products of decomposition are mainly nitric oxide and nitrogen, in the second they are chiefly nitrogen peroxide and oxygen. It is difficult to distinguish sharply between these two stages, and an intermediate phase has been observed:

$$Ba(NO_3)_2 = Ba(NO_2)_2 + O_2.$$

The decomposition of magnesium nitrite begins at 60°, and at 120° that of the first stage is complete, resulting in the formation of a basic nitrate, $Mg(NO_3)_2,MgO$, which is stable even at 175°.

***202. "The metallic derivatives of nitrogen iodide and their bearing on its constitution." By Oswald Silberrad.**

On examining Guyard's copper derivative (compare *Compt. rend.*, 1884, 97, 526), the compound was found to be a *cuprosamine periodide*, $Cu_2I_2(5NH_3)I_4,H_2O$, and not a derivative of nitrogen iodide; it is not explosive, and has the properties of a periodide. On heating, it evolves iodine vapour, and by treating with potassium iodide solution the loosely combined iodine is removed quantitatively. The regeneration of nitrogen iodide from the cuprosamine periodide by ammonia must also be regarded as distinct evidence of its periodide character, for, according to this view, the loosely combined iodine reacts with ammonia precisely as does potassium periodide.

Cuprosamine Iodide, $Cu_2I_2,NH_3,4H_2O$.—When the foregoing periodide is treated with potassium iodide solution, the loosely combined iodine is removed and a green, crystalline residue remains behind, which dries to an olive-green, crystalline powder having the above formula; it is insoluble in water, but dissolves fairly readily in ammonia.

The silver derivative formulated by Szuhay as $AgNI_2$ (*Ber.*, 1893, 26, 1933) was again investigated, but it was found that by following his method a compound of constant composition could not be prepared. By the addition of iodine chloride solution to an ammoniacal silver solution, a pure product having the formula NI_3NH_2Ag was obtained. The substance decomposes readily, even at the ordinary temperature and especially when exposed to light; in the dry state, it explodes on the slightest friction. It dissolves readily in potassium cyanide and is regenerated by the addition of ammoniacal silver nitrate. Szuhay

stated that an intermediate potassium salt was formed. This is disproved by an examination of the solution obtained by adding potassium cyanide to nitrogen iodide. Exactly 3 mols. of potassium cyanide were required to dissolve 1 mol. of nitrogen iodide, this number being independent of the excess of ammonia present. The products identified were cyanogen iodide, potassium iodide, potassium carbonate, potassium cyanate, ammonia, and cyanogen. The mechanism of the change is as follows :

1. $3KCN + NH_3NI_3 + 3H_2O = 3CNI + 3KOH + 2NH_3$.
2. $CNI + 2KOH = KCNO + KI + H_2O$.
3. $2KCNO + 3H_2O = K_2CO_3 + 2NH_3 + CO_2$.

At low temperatures and in concentrated solution, the cyanogen iodide is partially precipitated, but at the ordinary temperature it rapidly decomposes in solution.

The action of potassium cyanide on the silver derivative took place in accordance with the equation :

$$NI_3{:}NH_2Ag + 4KCN + 4H_2O = 3CNI + AgCN + 4KOH + 2NH_3.$$

It was also found that although cyanogen iodide produced no precipitate of nitrogen iodide when added to ammonia, yet in the presence of silver the compound $NI_3{:}NH_2Ag$ was readily obtained. The behaviour of the silver compound towards potassium cyanide is thus fully explained without any necessity for assuming the existence of an intermediate potassium salt.

***203. "Synthesis of 1 : 1-dimethylhexahydrobenzene." By Arthur William Crossley and Nora Renouf.**

5-Chloro-3-keto-1 : 1-dimethyl-Δ^4-tetrahydrobenzene (*Trans.*, 1903, **83**, 117), when treated with sodium in moist ethereal solution, yields 3-*hydroxy*-1 : 1 *dimethylhexahydrobenzene*,

$$(CH_3)_2{\cdot}C\begin{<}CH_2{\cdot}CH(OH)\\CH_2\text{——}CH_2\end{>}CH_2,$$

together with other substances not yet investigated. The product is a clear colourless liquid boiling at 99·5°/35 mm. and having a marked odour of peppermint. When treated with fuming hydrobromic acid, it is converted into 3-*bromo*-1 : 1-*dimethylhexahydrobenzene*, a colourless liquid boiling at 98°/50 mm. The bromine atom in this compound is readily replaced by hydrogen on heating with zinc dust in aqueous alcoholic solution, giving rise to 1 : 1-*dimethylhexahydrobenzene*, which is a colourless refractive liquid boiling at 117°/743 mm. and having a geranium-like odour.

In 1902, Zelinsky (*Annalen*, 1902, 319, 318) described the prepara-

tion of dihydro*iso*laurolene, which hydrocarbon, he suggested, was 1 : 1-dimethylhexahydrobenzene, and the authors are at present comparing the properties of these two hydrocarbons, and also the properties of 1 : 1-dimethyltetrahydrobenzene, with the hydrocarbons of the formula C_8H_{14}, which have at various times been obtained from derivatives of camphor.

***204. "The formation and reactions of imino-compounds. I. Condensation of ethyl cyanoacetate with its sodium derivative." By Harold Baron, Frederick George Percy Remfry, and Jocelyn Field Thorpe.**

Ethyl cyanoacetate condenses with its sodium derivative forming the sodium compound of *ethyl α-cyano-β-iminoglutarate*,

$$CO_2Et\cdot CHNa\cdot C(:NH)\cdot CH(CN)\cdot CO_2Et,$$

which can readily be converted into *ethyl α-cyano-β-iminoglutarate*, $CO_2Et\cdot \underset{(1)\,(3)}{CH_2}\cdot C(:NH)\cdot \underset{(2)}{CH}(CN)\cdot CO_2Et$. This substance contains three hydrogen atoms capable of replacement by sodium in the order indicated by the numerals.

Ethyl α-cyano-β-iminoglutarate and its alkyl derivatives yield the corresponding ethyl hydrogen salts,

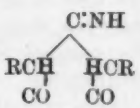
$$CO_2H\cdot CHR\cdot C(:NH)\cdot CR(CN)\cdot CO_2Et,$$

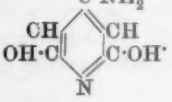
on hydrolysis with sodium carbonate.

These compounds, on heating above their melting points, are converted into derivatives of glutazine, which can be transformed into the corresponding derivatives of 2 : 4 : 6-trioxypyridine by suitable reagents.

The same glutazine derivatives are formed by the action of concentrated sulphuric acid on the diethyl salts.

The substitution derivatives of glutazine can react in the two forms:

I. 

II. 

The mono-substitution derivatives react in the second form towards acid hydrolysing agents, and in the first form towards nitrous acid.

The di-substitution derivatives react only in the second form, whilst the tri-substitution derivatives react in the first form.

Ethyl α-cyano-β-iminoglutamate,

$$CONH_2\cdot CH_2\cdot C(:NH)\cdot CH(CN)\cdot CO_2Et,$$

can be converted into a derivative of glutazine in two ways. Thus, with concentrated sulphuric acid, it yields *ethyl glutazinecarboxylate*, $NH<^{CO\text{———}CH_2}_{CO\cdot CH(CO_2Et)}>C:NH$, but with sodium carbonate solution it is converted into glutazine cyanide, $NH<^{CO\text{———}CH_2}_{CO\cdot CH(CN)}>C:NH$.

***205. "The affinity constants of aniline and its derivatives." By Robert Crosbie Farmer and Frederick John Warth.**

The affinity constants of aniline and its derivatives are best determined through the hydrolytic dissociation of their salts. For this purpose, the method of distribution between two solvents, previously employed by one of the authors (Farmer, *Trans.*, 1901, 79, 863), has been applied to these compounds. The advantages of the method are, mainly, its applicability to (1) sparingly soluble organic compounds, (2) strongly coloured solutions, (3) solutions in which a slight decomposition interferes with titrations, (4) salts which are hydrolysed to the extent of nearly 100 per cent. in solution.

Comparative experiments showed that the sulphates of aniline and the toluidines were in all instances hydrolysed to a greater extent than the corresponding hydrochlorides, but the relative difference decreased in dilute solution.

o-Nitroaniline showed practically no tendency to form a hydrochloride in aqueous solution, and *p*-nitroaniline was a much weaker base than the meta-isomeride. The nitroanilines exhibited no acidic properties when examined by the same method in presence of caustic potash.

The substituents arranged themselves in the following order as regards their influence on the affinity constant of aniline, the nitro-group being the most electronegative: NO_2, CO_2H, $\cdot N:N\cdot C_6H_5$, Br, Cl, CH_3, OCH_3. α- and β-Naphthylamines were somewhat weaker bases than aniline. Acetanilide and aceto-*o*-toluidide showed practically no basic properties. *p*-Nitrosomethylaniline possessed easily measurable acidic properties in addition to its basic properties, but *p*-nitrosodimethylaniline showed no tendency to form salts with alkalis.

206. "The attractive force of crystals for like molecules in saturated solutions." By Edward Sonstadt.

The author describes the preparation of saturated solutions in pairs or in sets, in which to one or more of the solutions is added a quantity of the crystals of the dissolved salt, the flasks or other containing vessels being left together in a cellar in which the temperature varies

only slowly. The added crystals draw from the solution in which they are deposited a certain portion of the salt, so that the supernatant liquid contains, after a time, an appreciably smaller proportion of the dissolved salt than the solutions contained in the other vessels, to which no crystals had been added. The determinations were made either by evaporating a weighed portion of each of the solutions and weighing the residue, or by taking the density of the solutions by a specific gravity bottle.

207. "**The Grignard reaction applied to the esters of hydroxy-acids.**" **By Percy Faraday Frankland and Douglas Frank Twiss.**

By acting on dimethyl tartrate with magnesium phenyl bromide and treating the product with dilute sulphuric acid, the authors have obtained a compound crystallising in small, white needles (m. p. 148°), which is presumably *aaδδ*-tetraphenylerythritol,

$$(C_6H_5)_2C(OH)\cdot CH(OH)\cdot CH(OH)\cdot C(OH)(C_6H_5)_2.$$

It is powerfully dextrorotatory, a 4·327 per cent. solution in ethyl alcohol giving $[\alpha]_D^{20°} + 182·8°$. The compound is isomeric with the already known benzoïnpinacone (tetraphenylerythritol, m. p. 235°), $C_6H_5\cdot CH(OH)\cdot C(OH)(C_6H_5)\cdot C(OH)(C_6H_5)\cdot CH(OH)\cdot C_6H_5$, obtained by Kauffmann (*Chem. Centr.*, 1898, I, 1232) by the electrolytic reduction of benzil or benzoïn, and which is, of course, inactive.

The authors, who are proceeding with the investigation, are making this preliminary communication in consequence of the incidental description by Acree (*Ber.*, 1904, **37**, 2753) of the action of magnesium phenyl bromide on inactive methyl mandelate with production of triphenylglycol.

208. "**Note on the addition of hydrogen cyanide to unsaturated compounds.**" **By Arthur Lapworth.**

Knoevenagel has recently stated (*Ber.*, 1904, **37**, 4065) that mesityl oxide unites nearly quantitatively with pure hydrogen cyanide, and in proof he cites the yield of mesitylic acid obtained by adding potassium hydroxide to the mixture after eight days and then boiling. As potassium cyanide, in presence of potassium hydroxide, rapidly converts mesityl oxide into mesitylic acid, Knoevenagel's experiment throws no light on the subject.

Experiments at 100° with hydrogen cyanide dissolved in alcohol are apt to be misleading, as after some hours at this temperature the solution is often faintly alkaline, and is much more reactive than before heating. The author has never obtained an appreciable amount of additive product when hydrocyanic acid free from all trace of basic

impurity was warmed with an $\alpha\beta$-unsaturated ketone; nevertheless, the views which he has put forward as to the mechanism of such processes are altogether opposed to the assumption that pure hydrogen cyanide is devoid of additive properties in any instance where addition occurs in presence of a base or a metallic cyanide (compare Knoevenagel, *loc. cit.*, p. 4067).

Alkylidenecyanoacetic acids react very readily with hydrogen cyanide in presence of bases or metallic cyanides; the products vary with the precise conditions imposed, but with care it is easy to obtain nearly quantitative yields of compounds derived from the type $CHX(CN)\cdot CH(CN)\cdot CO_2H$, and from which alkylsuccinic acids are produced by acid hydrolysis. For example, phenylsuccinic acid may rapidly be synthesised from benzaldehyde, potassium chloroacetate, and potassium cyanide. The study of this reaction as applied to both fatty and aromatic aldehydes is in progress. Alkylidenemalonic acids do not appear to be capable of uniting with hydrogen cyanide.

WISLICENUS MEMORIAL LECTURE.

The Wislicenus Memorial Lecture will be delivered by Professor W. H. Perkin, F.R.S., on **Wednesday**, January 25th, at **8.30** p.m.

At the next Ordinary Meeting, on **Wednesday**, December **14th**, at **5.30** p.m., the following papers will be communicated:—

"Hydrolysis of ammonium salts." By V. H. Veley.

"The viscosity of liquid mixtures. Part II." By A. E. Dunstan.

"The diazo-reaction in the diphenyl series. Part II. Ethoxybenzidine." By J. C. Cain.

"The sulphate and the phosphate of the dimercurammonium series." By P. C. Rây.

"A method for the direct production of certain aminoazo-compounds." By R. Meldola and L. Eynon.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 31/12/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 287.

Wednesday, December 14th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. J. C. Cain and W. H. Willcox were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

James Hector Barnes, B.Sc., The Briars, King's Norton, Birmingham.
Bernard Mount Jones, B.A, "Alcala," Hermitage Road, Upper Norwood, S.E.
Herbert Louis Leech, 3, London Road, Blackburn.
Alfred Courtenay Luck, The Naval Arsenal, Zarate, Argentina.
Andrew Norman Meldrum, D.Sc., 16, Mooroaks Road, Sheffield.
Charles Watson Moore, B.Sc., 38, Demesne Road, Whalley Range, Manchester.
Ernest Quant, 2, Park Crescent, Torquay.
Gustav Arthur Troye, P.O. Box 2706, Johannesburg.
William Phillip Want, 11, Pearfield Road, Forest Hill, S.E.
John Wells Wilkinson, M.A., 28, Egerton Terrace, Bexley Road, Belvedere.
Alan Herbert Williams, 127, Roseneath Road, Urmston, near Manchester.

The following Certificate was authorised by Council under Bye-law I (3):

H. Chandra Chatterjee, Cawnpore, India.

Of the following papers, those marked * were read:

*209. "Hydrolysis of ammonium salts." By Victor Herbert Veley.

When aqueous solutions of ammonium salts are heated to their boiling points, the evolution of ammonia and the concomitant acidity of the solutions result not from a direct dissociation, but from hydrolysis. Three cases are presented: (i) the hydrolysis is *nil* or inappreciable, (ii) it is dependent on the dilution, and (iii) it is independent of dilution when beyond a certain limiting value.

The persistence or avidity with which the several acids retain the ammonia in combination is analogous to their activity or avidity in the cases of hydrolysis of methyl acetate and the inversion of cane sugar, the relative, but not the absolute, order of magnitude being the same in all these three chemical changes.

Discussion.

Professor Crossley said that this behaviour of ammonium salts on distillation was capable of being of great service in the separation of organic acids, and instanced the case (*Trans.*, 1898, 73, 13) where it had been found possible to separate *iso*propylsuccinic acid from a complicated mixture of fatty acids by distilling in steam a solution of the mixed acids in ammonium hydroxide, when ammonium *iso*propylsuccinate was left in the residue.

*210. "The viscosity of liquid mixtures. Part II." By Albert Ernest Dunstan.

The author's conclusions in a previous paper (*Trans.*, 1904, 85, 817) are confirmed by the present series of results, and by means of a slightly modified apparatus the viscosity-concentration curves for the following mixtures have been investigated.

1. Allyl alcohol and water:—Maximum point at 51—52 per cent. allyl alcohol, corresponding with 1 allyl alcohol, 3 water, and a discontinuity with 40 per cent. allyl alcohol corresponding with 1 allyl alcohol, 5 water.

2. Propyl alcohol and water:—Maximum point at 61—62 per cent. propyl alcohol, corresponding with 1 propyl alcohol, 2 water.

3. Glycol and water:—Sagged curve approximating to the normal. Maximum divergence from the straight line at the point 1 glycol, 2 water.

4. Lactic acid and water:—Sagged curve as for glycol and water. Maximum divergence at the point 1 lactic acid, 2 water.

5. Benzene and acetic acid:—Minimum point at 89 per cent. benzene, corresponding with 5 benzene, 1 acetic acid.

6. Benzene and propyl alcohol:—Minimum point at 95 per cent. benzene, corresponding with 12 benzene, 1 propyl alcohol.

Although it might be expected that such very viscous substances as glycol and lactic acid, which at the same time are associative, would give maximum points in a similar way to other hydroxylated liquids, yet this is not the case, because further association or the formation of higher complexes with water is impossible; a breaking down into simpler groups takes place, although it is quite likely that aggregates are formed as in other cases.

The minima obtained with benzene solutions are regarded as being due to the formation of definite aggregates less complex than those of the original hydroxylated substances.

***211. "The diazo-reaction in the diphenyl series. Part II. Ethoxybenzidine." By John Cannell Cain.**

The author has examined the action of heat on the solution of the diazonium salt prepared from ethoxybenzidine and has shown that one diazonium group is normally substituted by hydroxyl whilst the other remains intact. It seems certain from the fact that dianisidine is much more stable than benzidine in this connection that the diazonium group which is adjacent to the ethoxy-group is the one which remains unchanged. The diazonium sulphate has the formula $OH\cdot C_6H_4\cdot C_6H_3(OEt)\cdot N(:N)\cdot HSO_4$, and can be recrystallised from boiling dilute sulphuric acid; it forms long, acicular, brown crystals easily soluble in water. The free diazonium hydroxide is precipitated by sodium carbonate as a lilac mass which dissolves in acids forming the corresponding salts.

4′-Hydroxy-3-ethoxydiphenyl-4-diazonium sulphate and the corresponding chloride, bromide, iodide, nitrate, and platinichloride have been prepared.

***212. "The sulphate and the phosphate of the dimercurammonium series." By Prafulla Chandra Rây.**

It has already been shown that when dimercurammonium nitrite, NHg_2NO_2, is treated with a halogen acid the molecular structure

of the compound is destroyed, and a double salt of the type $2HgX_2,NH_4X$ is formed, where X represents a halogen atom (*Trans.*, 1902, **81**, 644). If, however, an oxy-acid is substituted for the halogen acid, the *dimercurammonium* complex remains intact, and the NO_2-group is simply replaced by the corresponding acid ion. In this way, the author has lately succeeded in preparing the sulphate, $(NHg_2)_2SO_4,H_2O$, and the phosphate, $NHgH_2PO_4$, of the series.

***213. "A method for the direct production of certain aminoazo-compounds." By Raphael Meldola and Lewis Eynon.**

The authors have found that most diazotised amines when treated in aqueous solution with a strong solution of sodium dichromate give crystalline precipitates of diazonium chromates which can be isolated and used in the solid condition. It is pointed out that this method is at present the only practical process for isolating diazonium salts with inorganic acid radicles from aqueous solutions. In the case of diamines, a means for the direct production of aminoazo-compounds has thus been found. Diazotised *p*-phenylenediamine gives a chromate having the formula $NH_2{\cdot}C_6H_4{\cdot}N_2{\cdot}HCrO_4$, which combines at once with phenols and amines to form aminoazo-compounds. *p*-Aminobenzeneazo-β-naphthol (*Trans.*, 1885, **47**, 663) has been prepared by this method and characterised by its acetyl derivative, which crystallises in red needles melting at 259—260°. *p*-Aminophenol forms a normal diazonium dichromate, $[HO{\cdot}C_6H_4{\cdot}N_2]_2Cr_2O_7$. These solid chromates are all more or less explosive when dry, and it is suggested that some of them might find technical application as high explosives.

Discussion.

Dr. Hewitt said that the much greater stability of *p*-aminophenyldiazonium salts as compared with salts not containing an amino-group may perhaps be accounted for by assuming that the former compounds have a quinonoid constitution. Professor Meldola's chromate would then have the formula $NH{:}C_6H_4{:}N_2H{\cdot}HCrO_4$, whilst the stable diazonium sulphate just described by Dr. Cain would have a similar formula, $O{:}C_6H_4{:}C_6H_3(OEt){:}N_2H{\cdot}HSO_4$.

Dr. Cain inquired whether the diazonium chromate of *p*-nitroaniline had been prepared. It would be interesting to know whether this salt gave the ordinary "*p*-nitraniline red" on cloth padded with β-naphthol or whether the chromic acid had any effect on the colour produced on the fibre.

Prof. Meldola, in reply to Dr. Cain, said that he had prepared diazonium chromates of the nitroanilines, but these substances were

highly explosive when dry, and dangerous to make in quantity. In the moist state, they might perhaps be used for the purpose indicated. With reference to a question by Dr. Morgan, he had not been able to isolate chromates of the tetrazo-derivatives of simple diamines. With the heteronucleal diamines of the diphenyl series, it might be possible to obtain such tetrazonium chromates, but the experiments had not been carried very far in this direction at present. He agreed with Dr. Hewitt as to the remarkable stability of some of these diazonium chromates, but as to the inference that these salts might have a quinonoid structure on account of their colour, the fact that the acid radicle was itself coloured interfered with this interpretation, although there was no valid objection against such a view of their constitution.

*214. "The combination of mercaptans with olefinic ketonic compounds." By Siegfried Ruhemann.

According to Posner's researches (*Ber.*, 1901, **34**, 1395; 1902, **35**, 799; 1904, **37**, 502), mercaptans generally interact with mono-olefinic ketones in the presence of hydrogen chloride, both by addition at the ethylene linking and by condensation with the ketonic group, to yield trithio-compounds.

The author showed that, on using piperidine or sodium ethoxide as catalytic agents, instead of hydrogen chloride, only additive products of mercaptans with the olefinic ketonic compounds $-\overset{|}{C}\cdot\overset{|}{C}\cdot CO-$ are formed, and several substances of this type have been obtained from benzylideneacetone, ethyl benzylideneacetoacetate, benzylideneacetylacetone, and benzylidenebenzoylacetone.

Moreover, in the presence of piperidine, dibenzylideneacetone, a diolefinic ketone containing the residue $\overset{|}{C}\cdot\overset{|}{C}\cdot CO\cdot\overset{|}{C}\cdot\overset{|}{C}$, unites either with 1 or 2 molecular proportions of a mercaptan, whilst Posner, by means of hydrogen chloride, has only been able to obtain additive products with 2 mols. of mercaptans. On the other hand, cinnamylideneacetophenone, a ketone with the grouping $\overset{|}{C}\cdot\overset{|}{C}\cdot\overset{|}{C}\cdot\overset{|}{C}\cdot CO-$, takes up only one molecule of either *iso*amyl mercaptan or phenyl mercaptan; whilst according to Posner, this ketone, under the influence of hydrogen chloride, unites with 2 mols. of mercaptans. The author has, however, obtained from this ketone and phenyl mercaptan a compound identical with the substance described by Posner, but which has the formula $CHPh{:}CH\cdot CH(SPh)\cdot CH_2\cdot COPh$, and not $CHPh(SPh)\cdot CH_2\cdot CH(SPh)\cdot CH_2\cdot COPh$, as stated by this investigator.

215. "Studies in optical superposition. Part I." By Thomas Stewart Patterson and Francis Taylor.

Menthyl acetate, *l*-menthyl *d*-tartrate, and *l*-menthyl diacetyl-*d*-tartrate have been prepared and their rotations examined between 0° and 100° and compared with each other and with that of menthol between the same temperatures. Menthyl diacetyltartrate is dimorphous, one modification melting at 84·5° and the other at 108°. It is shown that for menthol there is a temperature (58—59°) of minimum rotation (maximum negative rotation), but no such temperature has been observed for its derivatives. It is shown to be possible by analogy to trace the separate effects of the different active groups composing menthyl tartrate and its diacetyl derivative.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bolton, Henry Carrington. A select bibliography of chemistry, 1492—1902. 2nd supplement. Smith. Mis. Coll. Vol. XLIV. Washington 1904. From the Smithsonian Institution.

Dobbin, Leonard, and Marshall, Hugh. Salts and their reactions. With a preface by A. Crum Brown. pp. 198. Edinburgh 1904. From the Authors.

Gordon Memorial College, Khartoum. First report of the Wellcome Research Laboratories. By the director, Andrew Balfour. pp. 84 + iii. ill. Khartoum 1904. From the Director.

Haldane, J. S., and Wade, John. Reports to the Local Government Board on the destruction of rats and disinfection on shipboard. pp. 28. ill. London 1904. From the Local Government Board.

Lewkowitsch, J. Cantor lectures on oils and fats: their uses and applications. pp. 52. ill. London 1904. From the Author.

Lewkowitsch, J. Chemical technology and analysis of oils, fats, and waxes. Third edition. pp. 1152. ill. 2 vols. London 1904. From the Author.

Lodge, Richard W. Notes on assaying, and metallurgical laboratory experiments. pp. viii + 287. ill. New York 1904. From the Publishers.

Rostoski, O. Manual of serum diagnosis. Authorised translation by Charles Bolduan. pp. 86. ill. New York 1904. From the Publishers.

Thomson, J. J. Elektrizität und Materie. Autorisierte Übersetzung von G. Siebert. pp. 100. Braunschweig 1904.

From the Publishers.

II. *By Purchase.*

Chemisch-technische Untersuchungsmethoden. Herausgegeben von Georg Lunge. Fünfte Auflage. Bände 1 und 2. pp. xxvi + 953 + xlix, xix + 842 + viii. ill. Berlin 1904.

De la Coux, H. L'ozone et ses applications industrielles. Propriétés physiques—Physiologie—Production—Actions chimique et microbiologique—Applications—Analyse. pp. 557. ill. Paris 1904.

Hager, Hermann. Das Mikroskop und seine Anwendung. Handbuch der praktischen Mikroskopie und Anleitung zu mikroskopischen Untersuchungen. Nach dessen Tode vollständig umgearbeitet und in Gemeinschaft mit O. Appel, G. Brandes, P. Stolper, neu herausgegeben von Carl Mez. Neunte Auflage. pp. xii + 392. ill. Berlin 1904.

Hantzsch, A. Grundriss der Stereochemie. Zweite Auflage. pp. viii + 188. Leipzig 1904.

Kobert, Rudolf. Lehrbuch der Intoxikationen. II Band, 1 Hälfte. Zweite Auflage. pp. 400. ill. Stuttgart 1904.

Schelenz, Hermann. Geschichte der Pharmazie. pp. xi + 935. Berlin 1904.

III. *Pamphlets.*

Borns, H. Die Elektrochemie im Jahre 1903. (From *Die Chemische Industrie*, 27, 1904.)

Chace, Ed. Mackay, Tolman, L. M., and Munson, L. S. Chemical composition of some tropical fruits and their products. I. A study of Cuban fruits. II. The composition of fresh and canned pine-apples. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 87.)

Dymond, T. S., and Bull, B. W. Variation in the milk of a dairy herd during the summer months. pp. 15. Chelmsford 1904.

—— Variation in the milk of a dairy herd during the winter months. pp. 19. Chelmsford 1903.

Dymond, T. S., and Hughes, F. Notes on agricultural analyses, made in the County Technical Laboratories, Chelmsford, during 1901—1903. pp. 50. Chelmsford 1904.

Grindley, H. S. The nitrogenous constituents of flesh. (From *J. Amer. Chem. Soc.*, 26, 1904.)

Haywood, J. K., and Warner, H. J. Arsenic in papers and fabrics. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 86.)

Howard, Albert. Hop experiments, 1904. pp. 29. ill. Kent 1904.

Richardson, Clifford. The constitution of Portland cement from a physico-chemical standpoint. pp. 20. New York 1904.

Storer, F. H. A supplement to the article (No. 3) on the occurrence of mannan in trees, roots, and fruit. (From the *Bulletin of the Bussey Institution*, 3, 1904.)

Tolman, L. M., and Munson, L. S. Olive oil and its substitutes. (U.S. Dept. of Agric. Bureau of Chemistry Bulletin, No. 77.)

Travers, Morris W. Researches on the attainment of very low temperatures. (From the *Smithsonian Miscellaneous Collections*, 46, 1904.)

Wiley, Harvey W. The influence of environment upon the composition of the sugar beet, 1902, including a study of irrigated sections. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 78.)

WISLICENUS MEMORIAL LECTURE.

The Wislicenus Memorial Lecture will be delivered by Professor W. H. Perkin, F.R.S., on **Wednesday**, January 25th, 1905, at **8.30** p.m.

At the next Meeting, on **Wednesday**, January **18th**, 1905, at **5.30** p.m., the following papers will be communicated :—

"Nitrogen halogen derivatives of the sulphonamides. Part I. Sulphondichloroamides and sulphonalkylchloroamides." By F. D. Chattaway.

"Nitrogen halogen derivatives of the sulphonamides. Part II. Sulphondibromoamides and sulphonalkylbromoamides." By F. D. Chattaway.

"Electrolytic oxidation of aliphatic aldehydes." By H. D. Law.

"The diazo-derivatives of the benzenesulphonylphenylenediamines." By G. T. Morgan and F. M. G. Micklethwait.

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